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Prílohy

Príloha 1 – Kovalentné, kovové a iónové polomery

Hodnoty kovalentných polomerov *r*k sú experimentálne polomery získané analýzou kryštalografických údajov. Hodnoty sú prevzaté z Cordero, B., Gómez, V., Platero-Prats A. E., Revés, M., Echeverría, J., Cremades, E., Barragán, F., Alvarez, S.: *Covalent radii revisited*, Dalton Trans., 21, 2832 – 2838, 2008.

Hodnoty kovových polomerov *r*m vyjadrujú vzdialenosť kov-kov v najstálejšej modifikácii kovového (nekovového) prvku za štandardných podmienok a za predpokladu, že kovový prvok je
12-koordinovaný. Hodnoty sú prevzaté z Kaye G. W. C., Laby, T. H.: *Tables of physical and chemical constants*, 15th ed., Longman, London, UK 1993, alebo z Porterfield, W. W.: *Inorganic chemistry – a unified approach*, Addison Wesley Publishing Co., Reading, Massachusetts, USA 1984.

Hodnoty iónových polomerov *r*i(E*q*) vyjadrujú polomer iónu z nábojom *q* pri jeho oktaédrickom obklopení opačne nabitými iónmi v iónovej zlúčenine. Hodnoty sú prevzaté z Shannon, R. D.: Revised Effective Ionic Radii and Systematic Studies of Interatomic Distances in Halides and Chalcogenides., *Acta Crystallographica A*, 32 (5), 751 – 767, 1976.

| Prvok | *Z* | *r*k / pm | *r*m / pm | (*q*) *r*i(E*q*) / pm |
| --- | --- | --- | --- | --- |
| H | 1 | 31 | – | (1+) 0(1–) 154 |
| He | 2 | 28 | – |  |
| Li | 3 | 128 | 156 | (1+) 76 |
| Be | 4 | 96 | 112 | (2+) 45 |
| B | 5 | 84 | 98 | (3+) 27 |
| C | 6 | 76 | 86 | (4–) 260(4+) 16 |
| N | 7 | 71 | 53 | (3–) 146(3+) 16 |
| O | 8 | 66 | – | (2–) 140 |
| F | 9 | 57 | – | (1–) 133 |
| Ne | 10 | 58 | – |  |
| Na | 11 | 166 | 191 | (1+) 102 |
| Mg | 12 | 141 | 160 | (2+) 72 |
| Al | 13 | 121 | 143 | (3+) 53,5 |
| Si | 14 | 111 | 138 | (4–) 271(4+) 40 |
| P | 15 | 107 | 128 | (3–) 212(3+) 44 |
| S | 16 | 105 | 127 | (2–) 184(4+) 37 |
| Cl | 17 | 102 | 91 | (1–) 181 |
| Ar | 18 | 106 | – |  |
| K | 19 | 220 | 235 | (1+) 138 |
| Ca | 20 | 176 | 197 | (2+) 100 |
| Sc | 21 | 170 | 164 | (3+) 74,5 |
| Ti | 22 | 160 | 147 | (2+) 86(3+) 67 |
| V | 23 | 153 | 135 | (2+) 79(3+) 64 |
| Cr | 24 | 139 | 129 | (2+) 80(3+) 61,5 |
| Mn | 25 | 139 | 127 | (2+) 83,3(4+) 53 |
| Fe | 26 | 132 | 126 | (2+) 78(3+) 65,5 |
| Co | 27 | 126 | 125 | (2+) 74,5(3+) 54,5 |
| Ni | 28 | 124 | 125 | (2+) 69(3+) 60 |
| Cu | 29 | 132 | 128 | (1+) 77(2+) 73 |
| Zn | 30 | 122 | 136 | (2+) 74 |
| Ga | 31 | 122 | 140 | (3+) 62 |
| Ge | 32 | 120 | 144 | (2+) 73(4+) 53 |
| As | 33 | 119 | 148 | (3–) 222(3+) 58 |
| Se | 34 | 120 | 140 | (2–) 198(4+) 50 |
| Br | 35 | 120 | 117 | (1–) 196 |
| Kr | 36 | 116 | – |  |
| Rb | 37 | 220 | 248 | (1+) 152 |
| Sr | 38 | 195 | 215 | (2+) 118 |
| Y | 39 | 190 | 180 | (3+) 90 |
| Zr | 40 | 175 | 160 | (4+) 72 |
| Nb | 41 | 164 | 146 | (3+) 72(5+) 64 |
| Mo | 42 | 154 | 139 | (3+) 69(4+) 65 |
| Tc | 43 | 147 | 136 | (4+) 64,5 |
| Ru | 44 | 146 | 134 | (3+) 66,5(4+) 62 |
| Rh | 45 | 142 | 134 | (3+) 66,5(4+) 60 |
| Pd | 46 | 139 | 137 | (2+) 86(4+) 61,5 |
| Ag | 47 | 145 | 144 | (1+) 115(2+) 94 |
| Cd | 48 | 144 | 151 | (2+) 95 |
| In | 49 | 142 | 158 | (3+) 80 |
| Sn | 50 | 139 | 163 | (2+) 118(4+) 69 |
| Sb | 51 | 139 | 166 | (3+) 76(5+) 60 |
| Te | 52 | 138 | 160 | (2–) 221(4+) 97 |
| I | 53 | 139 | 139 | (1–) 220(3+) 95 |
| Xe | 54 | 140 | – | (8+) 48 |
| Cs | 55 | 244 | 267 | (1+) 167 |
| Ba | 56 | 215 | 222 | (2+) 135 |
| La | 57 | 207 | 188 | (3+) 103,2 |
| Ce | 58 | 204 | 183 | (3+) 101(4+) 87 |
| Pr | 59 | 203 | 183 | (3+) 99(4+) 85 |
| Nd | 60 | 201 | 182 | (2+) 119(3+) 98,3 |
| Pm | 61 | 199 | 181 | (3+) 97 |
| Sm | 62 | 198 | 180 | (2+) 122(3+) 95,8 |
| Eu | 63 | 198 | 204 | (2+) 117(3+) 89 |
| Gd | 64 | 196 | 180 | (3+) 93,8 |
| Tb | 65 | 194 | 178 | (3+) 92,3(4+) 76 |
| Dy | 66 | 192 | 177 | (2+) 107(3+) 91,2 |
| Ho | 67 | 192 | 177 | (3+) 90,1 |
| Er | 68 | 189 | 176 | (3+) 89 |
| Tm | 69 | 190 | 175 | (2+) 103(3+) 88 |
| Yb | 70 | 187 | 194 | (2+) 102(3+) 86,8 |
| Lu | 71 | 187 | 173 | (3+) 86,1 |
| Hf | 72 | 175 | 159 | (4+) 71 |
| Ta | 73 | 170 | 146 | (3+) 72(5+) 64 |
| W | 74 | 162 | 139 | (4+) 66 |
| Re | 75 | 151 | 137 | (4+) 63 |
| Os | 76 | 144 | 135 | (4+) 63(6+) 54,5 |
| Ir | 77 | 141 | 136 | (3+) 68(4+) 62,5 |
| Pt | 78 | 136 | 139 | (2+) 80(4+) 62,5 |
| Au | 79 | 136 | 144 | (1+) 137(3+) 85 |
| Hg | 80 | 132 | 151 | (1+) 119(2+) 102 |
| Tl | 81 | 145 | 160 | (1+) 150(3+) 88,5 |
| Pb | 82 | 146 | 170 | (2+) 119(4+) 77,5 |
| Bi | 83 | 148 | 178 | (3+) 103 |
| Po | 84 | 140 | – | (4+) 94 |
| At | 85 | 150 | – | (7+) 62(1–) 227 |
| Rn | 86 | 150 | – |  |
| Fr | 87 | 260 | – | (1+) 180 |
| Ra | 88 | 221 | – | (2+) 148 |
| Ac | 89 | 215 | 190 | (3+) 112 |
| Th | 90 | 206 | 180 | (4+) 94 |
| Pa | 91 | 200 | 164 | (3+) 104(4+) 90 |
| U | 92 | 196 | 154 | (3+) 102,5(4+) 89 |
| Np | 93 | 190 | 155 | (2+) 110(4+) 87 |
| Pu | 94 | 187 | 159 | (3+) 100(4+) 86 |
| Am | 95 | 180 | 173 | (2+) 121(3+) 97,5 |
| Cm | 96 | 169 | 174 | (3+) 97(4+) 85 |
| Bk | 97 | – | 170 | (3+) 96(4+) 83 |
| Cf | 98 | – | 186 | (3+) 95(4+) 82,1 |
| Es | 99 | – | 186 |  |
| Fm | 100 | – | 194 |  |
| Md | 101 | – | 194 |  |
| No | 102 | – | 194 | (2+) 110 |
| Lr | 103 | – | 171 |  |

Príloha 2 – Paulingove elektronegativity prvkov

Paulingove elektronegativity *χ*P (eV1/2) sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011 alebo z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| H2,20 | 2 |  |  |  |  |  |  |  | 13 | 14 | 15 | 16 | 17 |
| Li0,98 | Be1,57 |  |  |  |  |  |  |  |  |  |  | B2,04 | C2,55 | N3,04 | O3,44 | F3,98 |
| Na0,93 | Mg1,31 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Al1,61 | Si1,90 | P2,19 | S2,58 | Cl3,16 |
| K0,82 | Ca1,00 | Sc1,36 | Ti1,54 | V1,63 | Cr1,66 | Mn1,55 | Fe1,83 | Co1,88 | Ni1,91 | Cu1,90 | Zn1,65 | Ga1,81 | Ge2,01 | As2,18 | Se2,55 | Br2,96 |
| Rb0,82 | Sr0,95 | Y1,22 | Zr1,33 | Nb1,60 | Mo2,16 | Tc2,10 | Ru2,20 | Rh2,28 | Pd2,20 | Ag1,93 | Cd1,69 | In1,78 | Sn1,96 | Sb2,05 | Te2,10 | I2,66 |
| Cs0,79 | Ba0,89 | La1,10 | Hf1,30 | Ta1,50 | W1,70 | Re1,90 | Os2,20 | Ir2,20 | Pt2,28 | Au2,54 | Hg2,00 | Tl2,04 | Pb2,33 | Bi2,02 | Po2,00 | At2,20 |

Príloha 3 – Allredove-Rochowove elektronegativity prvkov

Allredove-Rochowove elektronegativity *χ*AR (pm–2) sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011 alebo z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| H2,20 | 2 |  |  |  |  |  |  |  | 13 | 14 | 15 | 16 | 17 |
| Li0,97 | Be1,47 |  |  |  |  |  |  |  |  |  |  | B2,01 | C2,50 | N3,07 | O3,50 | F4,10 |
| Na1,01 | Mg1,23 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Al1,47 | Si1,74 | P2,06 | S2,44 | Cl2,83 |
| K0,91 | Ca1,04 | Sc1,20 | Ti1,32 | V1,45 | Cr1,56 | Mn1,60 | Fe1,64 | Co1,70 | Ni1,75 | Cu1,75 | Zn1,66 | Ga1,82 | Ge2,02 | As2,20 | Se2,48 | Br2,74 |
| Rb0,89 | Sr0,99 | Y1,11 | Zr1,22 | Nb1,23 | Mo1,30 | Tc1,36 | Ru1,42 | Rh1,45 | Pd1,35 | Ag1,42 | Cd1,46 | In1,49 | Sn1,72 | Sb1,82 | Te2,01 | I2,21 |
| Cs0,86 | Ba0,97 | La1,08 | Hf1,23 | Ta1,33 | W1,40 | Re1,46 | Os1,52 | Ir1,55 | Pt1,44 | Au1,42 | Hg1,44 | Tl1,44 | Pb1,55 | Bi1,67 | Po1,76 | At1,90 |

Príloha 4 – Ionizačné energie

Hodnoty prvej ionizačnej energie *I*1 (kJ mol‒1). Prvá ionizačná energia predstavuje zmenu vnútornej energie pre dej E(g) → E+(g) + e‒ , *I*1 = Δ*U* (0 K). Uvedené údaje sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011 alebo z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 18 |
| H1312 | 2 |  |  |  |  |  |  |  | 13 | 14 | 15 | 16 | 17 | He2373 |
| Li520 | Be899 |  |  |  |  |  |  |  |  |  |  | B800 | C1086 | N1402 | O1313 | F1681 | Ne2080 |
| Na496 | Mg738 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Al578 | Si786 | P1012 | S1000 | Cl1251 | Ar1521 |
| K419 | Ca590 | Sc633 | Ti659 | V651 | Cr653 | Mn717 | Fe762 | Co760 | Ni736 | Cu746 | Zn906 | Ga579 | Ge762 | As944 | Se941 | Br1139 | Kr1351 |
| Rb403 | Sr549 | Y600 | Zr640 | Nb652 | Mo684 | Tc702 | Ru710 | Rh720 | Pd805 | Ag731 | Cd867 | In559 | Sn708 | Sb831 | Te869 | I1008 | Xe1170 |
| Cs375 | Ba503 | La538 | Hf659 | Ta728 | W758 | Re755 | Os814 | Ir865 | Pt865 | Au890 | Hg1007 | Tl590 | Pb716 | Bi703 | Po813 | At920 | Rn1037 |

Dalšie ionizačné energie *In* (kJ mol‒1) pre prvky druhej a tretej periódy. Druhá ionizačná energia predstavuje zmenu vnútornej energie pre dej E+(g) → E2+(g) + e‒ , *I*2 = Δ*U* (0 K). Ostatné ionizačné energie sú definované analogicky ako jednoelektrónové deje.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Prvok 2. periódy | *I*1 | *I*2 | *I*3 | *I*4 | *I*5 | *I*6 | *I*7 |
| Li | 520 | 7298 | 11815 |  |  |  |  |
| Be | 899 | 1757 | 14899 | 21007 | vnútorné elektróny |
| B | 800 | 2427 | 3660 | 25026 |  |  |  |
| C | 1086 | 2352 | 4621 | 6222 | 37831 |  |  |
| N | 1402 | 2856 | 4578 | 7474 | 9445 | 53260 |  |
| O | 1313 | 3389 | 5301 | 7469 | 10989 | 13325 | 71300 |
| F | 1681 | 3374 | 6051 | 8408 | 11022 | 15150 | 17850 |
| Ne | 2080 | 3952 | 6121 | 9371 | 12177 | 15238 | 20001 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Prvok 3. periódy | *I*1 | *I*2 | *I*3 | *I*4 | *I*5 | *I*6 | *I*7 |
| Na | 496 | 4562 | 6910 |  |  |  |  |
| Mg | 738 | 1451 | 7733 |  | vnútorné elektróny |
| Al | 578 | 1817 | 2745 | 11577 |  |  |  |
| Si | 786 | 1577 | 3232 | 4356 | 16091 |  |  |
| P | 1012 | 1907 | 2914 | 4964 | 6274 | 21267 |  |
| S | 1000 | 2252 | 3357 | 4556 | 7004 | 8496 | 27107 |
| Cl | 1251 | 2298 | 3822 | 5159 | 6542 | 9362 | 11018 |
| Ar | 1521 | 2666 | 3927 | 5771 | 7238 | 8781 | 11995 |

Príloha 5 – Elektrónové afinity

Hodnoty prvých elektrónových afinít *A*1 (kJ mol‒1) predstavujú vnútornú energiu spojenú s dejom
E(g) + e‒ → E‒(g) , *A*1 = Δ*U* (0 K). Údaje sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 18 |
| H–73 | 2 |  |  |  |  |  |  |  | 13 | 14 | 15 | 16 | 17 | He21 |
| Li–60 | Be37 |  |  |  |  |  |  |  |  |  |  | B–26 | C–123 | N7 | O–141 | F–328 | Ne29 |
| Na–53 | Mg31 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Al–42 | Si–134 | P–72 | S–201 | Cl–349 | Ar35 |
| K–48 | Ca186 | Sc–18 | Ti–8 | V–51 | Cr–65 | Mn94 | Fe–49 | Co–64 | Ni–112 | Cu–120 | Zn–9 | Ga–29 | Ge–119 | As–78 | Se–195 | Br–325 | Kr41 |
| Rb–47 | Sr146 | Y–30 | Zr–41 | Nb–86 | Mo–72 | Tc–53 | Ru–101 | Rh–110 | Pd–54 | Ag–125 | Cd26 | In–29 | Sn–107 | Sb–103 | Te–190 | I–295 | Xe43 |
| Cs–45 | Ba46 | La–53 | Hf–14 | Ta–31 | W–79 | Re–14 | Os–106 | Ir–151 | Pt–205 | Au–223 | Hg18 | Tl–19 | Pb–35 | Bi–91 | Po–127 | At–145 | Rn41 |

Príloha 6 – Nábojové hustoty

Nábojové hustoty niektorých vybraných katiónov a aniónov, vypočítané na základe vzťahu: nábojová hustota = *ne* / (4π*r*3/3), kde *r* je iónový polomer (oktaédrický ión), *e* je elementárny náboj a *n* je náboj častice v *e*. Hodnoty sú prevzaté z Rayner-Canham G., Overton T.: *Descriptive Inorganic Chemistry*, 5th ed., W. H. Freeman and Company, New York, USA 2010.

| Ión | Nábojová hustota,(C mm–3) | Ión | Nábojová hustota, (C mm–3) | Ión | Nábojová hustota, (C mm–3) |
| --- | --- | --- | --- | --- | --- |
| Ag+ | 15 | Ge2+ | 116 | S4+ | 1152 |
| Al3+ | 364 | Ge4+ | 508 | S6+ | 2883 |
| Al3+ | 770 \* | I– | 4 | Sb3+ | 157 |
| As3– | 12 | I7+ | 889 | Sb5+ | 471 |
| As3+ | 307 | In3+ | 138 | Sc3+ | 163 |
| As5+ | 884 | K+ | 11 | Se2– | 12 |
| B3+ | 1663 | Li+ | 98 \* | Se4+ | 583 |
| B3+ | 7334 \* | Mg2+ | 120 | Se6+ | 1305 |
| Ba2+ | 23 | Mn4+ | 508 | Si4+ | 970 |
| Be2+ | 1108 \* | Mn7+ | 1238 | Sn2+ | 54 |
| Bi3+ | 72 | MnO4– | 4 | Sn2+ | 54 |
| Bi5+ | 262 | N3– | 50 | Sn4+ | 267 |
| Br– | 6 | N3– | 6 | Sn4+ | 267 |
| C4+ | 6265 \* | Na+ | 24 | SO42– | 5 |
| Ca2+ | 52 | NH4+ | 11 | Sr2+ | 33 |
| Cl– | 8 | NO3– | 9 | Te2– | 9 |
| Cl7+ | 3880 | O2– | 13 | Te4+ | 112 |
| ClO4– | 3 | O2– | 40 | Te6+ | 668 |
| CN– | 7 | O22– | 19 | Ti4+ | 362 |
| CO32– | 17 | OH– | 23 | Tl+ | 9 |
| Cr3+ | 261 | P3– | 14 | Tl3+ | 105 |
| Cr6+ | 1175 | P3+ | 587 | V2+ | 95 |
| Cs+ | 6 | P5+ | 1358 | V3+ | 241 |
| Cu+ | 51 | Pb2+ | 32 | V4+ | 409 |
| Cu2+ | 116 | Pb4+ | 196 | V5+ | 607 |
| F– | 24 | Rb+ | 8 | Zn2+ | 112 |
| Ga3+ | 261 | S2– | 16 |  |  |

\* za predpokladu tetraédrickej koordinácie.

Príloha 7 – Disociačné energie väzieb

Vybrané disociačné energie väzieb *D* (pri 25 °C) niektorých dvojatómových a polyatómových molekúl. Údaje sú prevzaté z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

| Molekula (konkrétna väzba) | Disociačná energia*, D* /kJ mol–1 | Molekula (konkrétna väzba) | Disociačná energia*, D* /kJ mol–1 |
| --- | --- | --- | --- |
| AsH3 (H2As–H) | 319 | H2S2 (S–S) | 271 |
| BBr3 | 368 | HBr | 366 |
| BCl3 | 444 | HCl | 431 |
| BF3 | 646 | HF | 570 |
| BI3 | 210 | HI | 298 |
| Br2 | 194 | I2 | 152 |
| BrCl | 219 | IBr | 179 |
| BrF | 280 | ICl | 211 |
| C2H2 (C≡C) | 967 | IF | 272 |
| C2H4 (C=C) | 728 | Li2 | 105 |
| C2H6 (C–C) | 377 | N2 | 945 |
| C6H6 (C–C) | 518 | NH3 (H2N–H) | 450 |
| CH3OH (O–H) | 440 | NO | 632 |
| CH4 (H3C–H) | 439 | O2 | 498 |
| Cl2 | 243 | O2– | 268 |
| ClF | 261 | O2+ | 625 |
| CO | 1076 | O22– | 213 |
| CO2 | 804,3 | PH3 (H2P–H) | 351 |
| D2 | 443,32 | S2 | 425 |
| F2 | 159 | SbH3 (H2Sb–H) | 288 |
| H2 | 435,78 | Se2 | 331 |
| H2O (HO–H) | 497 | T2 | 446,67 |
| H2O (O–H) | 430 | Te2 | 258 |
| H2O2 (O–O) | 211 |  |  |

Príloha 8 – Priemerné väzbové energie

Priemerné hodnoty väzbových energií pre niektoré vybrané väzby. Hodnoty sú prevzaté zo Silberberg, M. S.: *Principles of General chemistry*, 2nd ed., McGraw-Hill Companies, Inc.,
New York, USA 2010 alebo z Rayner-Canham G., Overton T.: *Descriptive Inorganic Chemistry*, 5th ed., W. H. Freeman and Company, New York, USA 2010.

| Väzba | Väzbová energia, *E* / kJ mol–1 | Väzba | Väzbová energia, *E* / kJ mol–1 | Väzba | Väzbová energia, *E* / kJ mol–1 |
| --- | --- | --- | --- | --- | --- |
| As≡As | 380 | F–Cl | 193 | Pb–F | 331 |
| As–As | 146 | F–F | 159 | Pb–H | 259 |
| As–Br | 258 | F–I | 263 | Pb–Pb | 230 |
| As–Cl | 322 | F–Kr | 50 | P–Br | 272 |
| As–F | 484 | F–Xe | 133 | P–Cl | 331 |
| As–H | 247 | Ga–Ga | 113 | P–F | 490 |
| As–I | 200 | Ge–C | 256 | P–H | 320 |
| As–O | 301 | Ge–Cl | 337 | P–I | 184 |
| B=O | 636 | Ge–Ge | 188 | P–P | 200 |
| B–B | 293 | Ge–H | 286 | P–Si | 213 |
| B–Br | 377 | Ge–O | 350 | S=S | 425 |
| B–C | 372 | H–Br | 363 | Sb≡Sb | 295 |
| B–Cl | 456 | H–Cl | 427 | Sb–Br | 260 |
| B–F | 613 | H–F | 565 | Sb–Cl | 315 |
| Bi≡Bi | 192 | H–H | 432 | Sb–F | 440 |
| Bi–Br | 232 | H–I | 295 | Sb–I | 195 |
| Bi–Cl | 275 | I–I | 151 | S–Br | 218 |
| Bi–F | 393 | In–In | 100 | Sb–Sb | 121 |
| Bi–I | 168 | N≡N | 945 | S–Cl | 271 |
| B–O | 536 | N≡O | 631 | Se=Se | 272 |
| Br–Br | 193 | N=N | 418 | Se–F | 285 |
| Br–I | 175 | N=O | 607 | Se–Se | 172 |
| C≡C | 839 | N–Br | 243 | S–F | 327 |
| C≡N | 891 | N–Cl | 200 | S–H | 347 |
| C≡O | 1070 | N–F | 272 | S–I | 170 |
| C=C | 614 | N–H | 391 | Si=O | 642 |
| C=N | 615 | N–I | 159 | Si–Br | 310 |
| C=O | 745 | N–N | 160 | Si–Cl | 381 |
| C=S | 476 | N–O | 201 | Si–F | 565 |
| C–Br | 276 | N–P | 209 | Si–H | 323 |
| C–C | 347 | O=O | 498 | Si–I | 234 |
| C–Cl | 339 | O=P | 544 | Si–O | 452 |
| C–F | 453 | O=S | 525 | Si–O | 466 |
| C–H | 413 | O–Br | 234 | Si–S | 226 |
| C–I | 216 | O–Cl | 203 | Si–Si | 226 |
| Cl–Br | 215 | O–F | 190 | Sn–Br | 255 |
| Cl–Cl | 243 | O–H | 467 | Sn–C | 201 |
| Cl–Ge | 349 | O–I | 234 | Sn–Cl | 315 |
| Cl–I | 208 | O–O | 204 | Sn–H | 251 |
| Cl–Xe | 86 | O–P | 351 | Sn–I | 188 |
| C–N | 305 | O–S | 265 | Sn–O | 300 |
| C–O | 358 | P≡P | 481 | Sn–S | 217 |
| C–P | 264 | P=P | 310 | Sn–Sn | 160 |
| C–S | 259 | P=S | 347 | S–S | 266 |
| C–Si | 301 | Pb–C | 161 | Te=Te | 218 |
| F–Br | 212 | Pb–Cl | 252 | Te–Te | 126 |
| As≡As | 380 | F–Cl | 193 | Pb–F | 331 |
| H–Se | 276 |  |  |  |  |
| H–Te | 238 |  |  |  |  |

Príloha 9 – Mriežkové energie

Hodnoty vypočítaných mriežkových energií *Um* (celkové mriežkové potenciálne energie) niektorých kryštalických solí boli prevzaté z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

| Zlúčenina | *U*m */* kJ mol–1 | Zlúčenina | *U*m */* kJ mol–1 |
| --- | --- | --- | --- |
| LiF | 1030 | MgF2 | 2926 |
| LiCl | 834 | MgCl2 | 2477 |
| LiBr | 788 | MgBr2 | 2406 |
| LiI | 730 | MgI2 | 2293 |
| NaF | 910 | CaF2 | 2640 |
| NaCl | 769 | CaCl2 | 2268 |
| NaBr | 732 | CaBr2 | 2132 |
| NaI | 682 | CaI2 | 1971 |
| KF | 808 | SrF2 | 2476 |
| KCl | 701 | SrCl2 | 2142 |
| KBr | 671 | SrBr2 | 2070 |
| KI | 632 | SrI2 | 1984 |
| RbF | 774 | BaF2 | 2347 |
| RbCl | 680 | BaCl2 | 2046 |
| RbBr | 651 | BaBr2 | 1971 |
| RbI | 617 | BaI2 | 1862 |
| CsF | 744 | BeO | 4514 |
| CsCl | 657 | MgO | 3795 |
| CsBr | 632 | CaO | 3414 |
| CsI | 600 | SrO | 3217 |
| Li2O | 2799 | BaO | 3029 |
| Na2O | 2481 | AgF | 953 |
| K2O | 2238 | AgCl | 910 |
| Rb2O | 2163 | AgBr | 897 |
| Cs2O | 2131 | AgI | 881 |
| Cu2O | 3273 | Ag2O | 3002 |
| CuI | 948 | CuCl | 992 |
| CuBr | 969 |  |  |

Príloha 10 – Dĺžky väzieb

Experimentálne dĺžky väzieb niektorých vybraných molekúl v plynnom stave. Údaje sú prevzaté z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

| Molekula (konkrétna väzba) | Dĺžka väzby, *l* / pm | Molekula (konkrétna väzba) | Dĺžka väzby, *l* / pm |
| --- | --- | --- | --- |
| [BF4]– | 145 | HNO3 (O–H) | 96 |
| Al2Br6 (Al–Br; Al–Br\*) | 223,4; 243,3 | I2 | 266,6 |
| Al2Cl6 (Al–Cl; Al–Cl\*) | 206,1; 225,0 | ICl | 232,1 |
| AsH3 | 151,1 | KBr | 282 |
| B2H6 (B–H; B–H\*) | 119; 133 | KCl | 267 |
| B3N3H6 (B–N; B–H; N–H) | 143,5;120; 102 | LiCl | 202 |
| BBr3 | 187 | LiF | 156 |
| BCl3 | 175 | LiH | 159 |
| BF3 | 131,3 | N2 | 109,8 |
| BI3 | 210 | N2H4 (N–N; N–H) | 144,9; 102,1 |
| BN | 145 | N2O (N–N; N–O) | 112,8; 118,4 |
| BO33– | 138 | N2O3 (N–N; N–O; N–O\*) | 186,4; 114,2; 121,7 |
| Br2 | 228,1 | N2O4 (N–N; N–O) | 178,2; 119,0 |
| BrCl | 213,6 | N2O5 (N–O; N–O\*) | 149,8; 118,8 |
| BrF | 175,9 | N3– | 116 |
| C (diamant) | 154,5 | N5+ (N–N; N–N\*) | 110; 129 |
| C (grafit) | 141,5 | NaCl | 236 |
| C2– v CaC2 (C≡C) | 119,5 | NaF | 193 |
| C2H2 (C≡C) | 120,3 | NF3O (N–F; N–O) | 143,2; 115,9 |
| C2H4 (C=C) | 132,9 | NH2OH (N–O; N–H; O–H) | 145,3;101,6;96,2 |
| C2H4 (C–H) | 108,6 | NH3 | 101,2 |
| C2H6 (C–C; C–H) | 153,5; 109,1 | NO | 115,1 |
| C2H6 (C–C) | 153,5 | NO+ | 106,2 |
| C2H6 (C–H) | 109,1 | NO2 | 119,3 |
| C6H6 (C–C; C–H) | 140; 108,4 | NO2– | 124 |
| C6H6 (C–C) | 140 | NO2+ | 115 |
| C6H6 (C–H) | 108,4 | NO2Cl (N–O; N–Cl) | 120,2; 184,0 |
| CH2O (C–H) | 111,6 | NO2F (N–O; N–F) | 118; 146,7 |
| CH3CHF2 (C–C) | 149,8 | NO3– | 122 |
| CH3CHO (C–C) | 150,1 | NOBr (N–O; N–Br) | 115; 214 |
| CH3Cl (C–H) | 109 | NOCl (N–O; N–Cl) | 114; 197,5 |
| CH3OH (O–H) | 95,6 | NOF (N–O; N–F) | 113,6; 151,2 |
| CH4 (C–H) | 108,7 | O2 | 120,7 |
| Cl2 | 198,8 | O2– | 133 |
| Cl2O | 170 | O2+ | 112 |
| ClF | 162,8 | O22– | 149 |
| ClO2 | 147 | O3 | 128 |
| CO | 112,8 | O3– | 135 |
| CO2 | 116,2 | OF2 | 141 |
| CO32– | 129 | P2 | 189,5 |
| CO32– | 129 | P4 | 221 |
| COBr2 (C–O; C–Br) | 117,8; 192,3 | P4O10 | 143; 160 |
| COCl2 (C–O; C–Cl) | 117,9; 174,2 | P4O6 | 162 |
| COF2 (C–O; C–F) | 117,2; 131,6 | PBr3 | 222 |
| CsF | 235 | PCl3 | 204 |
| F2 | 141,2 | PCl5 (g) (P–Clax; P–Cleq) | 212,4; 202,2 |
| GeCl4 | 211 | PCl5(s) (PCl4+; [PCl6]–) | 197; 208 |
| GeF4 | 167 | PF3 | 157 |
| H2 | 74,1 | PH3 | 142 |
| H2O (O–H) | 95,7 | PI3 | 252 |
| H2O2 (O–O; O–H) | 148; 95 | POCl3 | 144,9 |
| H2S (S–H) | 133,5 | S2O32‒ (S–S; S‒O) | 201; 147 |
| H2S2 (S–S) | 206 | SbH3 | 170,4 |
| H2Se (Se–H) | 146 | SCl2 | 201 |
| H2Te (Te–H) | 169 | SF6 | 156 |
| HBr | 141,4 | SiCl4 | 201,9 |
| HCl | 127,5 | SiF4 | 155,3 |
| HCOOH (O–H) | 97,2 | SO2 (S=O) | 143 |
| HF | 91,7 | SO3 | 142 |
| HF2– (F–H) | 113 | SO32‒ | 151 |
| HI | 160,9 | SO42‒ | 149 |
| HN3 (N–N; N–N\*; N–H) | 124,5; 113,4; 101,5 | SOCl2 (S–O; S‒Cl) | 144; 207 |
| HNO3 (N–O; N–O\*; O–H) | 120,5; 141; 96 | SOF2 (S–O; S‒F) | 142; 158 |

Priemerné dĺžky väzieb niektorých vybraných kovalentných väzieb. Údaje sú prevzaté z Silberberg, M. S.: *Principles of General chemistry*, 2nd ed., McGraw-Hill Companies, Inc., New York, USA 2010.

| Väzba | Dĺžka väzby, *l* / pm | Väzba | Dĺžka väzby, *l* / pm |
| --- | --- | --- | --- |
| Al–Al | 270 | N–H | 391 |
| As–As | 246 | N–I | 222 |
| As–As | 246 | N–N | 146 |
| B–B | 178 | N–N | 147 |
| Br–Br | 228 | N–O | 144 |
| Br–I | 248 | N–P | 177 |
| C≡C | 121 | O=O | 121 |
| C≡N | 115 | O=S | 140 |
| C≡O | 113 | O–Br | 172 |
| C=C | 134 | O–Cl | 170 |
| C=N | 127 | O–F | 142 |
| C=O | 123 | O–H | 96 |
| C–Br | 194 | O–I | 194 |
| C–C | 154 | O–O | 148 |
| C–Cl | 177 | O–P | 160 |
| C–F | 133 | O–S | 163 |
| C–H | 109 | P–Br | 222 |
| C–I | 213 | P–Cl | 204 |
| Cl–Br | 214 | P–F | 156 |
| Cl–Cl | 199 | P–H | 320 |
| Cl–I | 243 | P–I | 243 |
| C–N | 147 | P–P | 221 |
| C–O | 143 | P–Si | 213 |
| C–P | 187 | S–Br | 225 |
| C–S | 181 | Sb–Sb | 296 |
| C–Si | 186 | S–Cl | 201 |
| F–Br | 178 | S–F | 158 |
| F–Cl | 166 | S–H | 134 |
| F–F | 143 | S–I | 234 |
| F–I | 187 | Si–Br | 216 |
| Ga–Ga | 244 | Si–Cl | 204 |
| Ge–Ge | 245 | Si–F | 156 |
| H–Br | 141 | Si–H | 148 |
| H–Cl | 127 | Si–I | 240 |
| H–F | 92 | Si–O | 161 |
| H–H | 74 | Si–S | 210 |
| H–I | 161 | Si–Si | 234 |
| I–I | 266 | Sn–Br | 255 |
| In–In | 276 | Sn–C | 215 |
| N≡N | 110 | Sn–Cl | 239 |
| N≡O | 106 | Sn–H | 215 |
| N=N | 122 | Sn–I | 269 |
| N=O | 120 | Sn–O | 215 |
| N–Br | 214 | Sn–S | 240 |
| N–Cl | 191 | Sn–Sn | 275 |
| N–F | 139 | S–S | 204 |

Príloha 11 – Teploty topenia a teploty varu

Teploty topenia a teplota varu niektorých vybraných zlúčenín sú prevzaté z Lide D. R. (ed.):
*CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010, alebo Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011.

| Zlúčenina | Teplota topenia, *t*t / °C | Teplota varu, *t*v / °C |
| --- | --- | --- |
| Ac | 1050 | 3200 |
| Al | 660,32 | 2519 |
| Al2O3 (α-forma, korund) | 2054 | 2977 |
| AlBr3 | 97,5 | 255 |
| AlCl3 | 192,6 | 180 (sublimácia) |
| AlF3 | 1040 | 1276 (sublimácia) |
| AlH3 | 150 (rozklad) | – |
| AlI3 | 188,28 | 382 |
| Ar | –189,4 (69 kPa) | –185,9 |
| As (šedá modifikácia) | 817 (3,70 MPa) | 616 (sublimácia) |
| AsBr3 | 31 | 221 |
| AsCl3 | –16 | 130 |
| AsF3 | –9 | 57 |
| AsF5 | –79,8 | –52,8 |
| AsH3 | –116 | –62,5 |
| B | 2075 | 4000 |
| B2H6 | –164,85 | –92,49 |
| B2O3 | 450 | – |
| B3N3H6 | –58 | 53 |
| B4H10 | –120 | 18 |
| B5H11 | –122 | 65 |
| B5H9 | –46,74 | 60,1 |
| B6H10 | –62,3 | 108 (rozklad) |
| BaCl2 | 960 | 1560 |
| BaH2 | 1200 | – |
| BaO | 1973 | 2000 |
| BBr3 | –46 | 91,3 |
| BCl3 | –107,3 | 12,5 |
| Be | 1287 | 2471 |
| BeCl2 | 415 | 482 |
| BeF2 | 552 | 1283 |
| BeH2 | 250 (rozklad) | – |
| BeO | 2578 | – |
| BF3 | –126,8 | –99,9 |
| Bi | 271,4 | 1564 |
| BI3 | 49,7 | 209,5 |
| BiH3 | –67 | ≈17 |
| BNH6 | 104 | – |
| Br2 | –7,2 | 58,8 |
| BrF5 | –60,5 | 41,3 |
| C (diamant) | 4440 (12,4 GPa) | – |
| C (grafit) | 4489 (10,3 MPa) | 3825 (sublimácia) |
| (C2H5)2O (dietyléter) | –116,3 | 34,6 |
| (C2H5)4Pb (tetraetylolovo) | –130 | 183 |
| C2H5OH (etanol) | –117,3 | 78,5 |
| C6H12 (cyklohexán) | 6,5 | 80,7 |
| C6H14 (hexán) | –95,4 | 68,7 |
| C6H5CH3 (toulén) | –93,0 | 110,6 |
| C6H6 (benzén) | 5,5 | 80,1 |
| Ca | 842 | 1484 |
| CaCl2 | 775 | 1935 |
| CaF2 | 1418 | 2500 |
| CaH2 | 1000 | – |
| CaO | 2613 | 2850 |
| CaS | 2524 | ‒ |
| CCl4 | –22,6 | 76,8 |
| CCl4 (chlorid uhličitý) | –22,9 | 76,8 |
| Cd | 321,07 | 767 |
| CdI2 | 388 | 744 |
| CF4 | –183,47 | –128 |
| (CH2)4O (tetrahydrofurán) | –108 | 66 |
| CH2Cl2 (dichlórmetán) | –95 | 39,8 |
| (CH3)2CO (acetón) | –95,3 | 56,2 |
| (CH3)2NCHO (dimetylformamid) | –60,4 | 153,0 |
| (CH3)2SO (dimetylsulfoxid) | 18,5 | 189,0 |
| CH3CN (acetonitril) | –43,8 | 81,6 |
| CH3F | –137,8 | –78,4 |
| CH3NO2 (nitrometán) | –29 | 101,2 |
| CH3OH (metanol) | –98 | 64,7 |
| CH4 | –182,47 | –161,48 |
| CHCl3 | –63,5 | 61,2 |
| Cl2 | –101,5 | –34,0 |
| Cl2O | ‒120,6 | 2,2 |
| Cl2O7 | –91,5 | 82 |
| ClF3 | –76,34 | 11,75 |
| ClF5 | –103 | –13,1 |
| ClO2 | –59 | 11 |
| CO | –205,02 | –191,5 |
| CO2 | –56,6 | –78,5 (sublimácia) |
| CO2 | –56,6 (pri 5,3 MPa) | –78,5(tsubl) |
| Cr | 1907 | 2671 |
| Cr2O3 | 2320 | ≈3000 |
| CrO3 | 197 | ≈250 (rozklad) |
| Cs | 28,4 | 671 |
| CS2 | –108,6 | 46,3 |
| CsH | 528 | – |
| D2 | –254,42 | –249,48 |
| D2O | 3,82 | 101,42 |
| F2 | –219,67 | –188,12 |
| Fe | 1538 | 2861 |
| Fe(CO)5 | ‒20,5 | 103 |
| Fe2O3 | 1539 | ‒ |
| FeS | 1188 | rozklad |
| Fr | 27 | – |
| Ga | 29,8 | 2204 |
| GaCl3 | 77,9 | 201 |
| GaF3 | >1000 | – |
| GaH3 | –15 | ≈0 (rozklad) |
| Ge | 938,25 | 2833 |
| GeCl4 | –51,5 | 86,55 |
| GeF2 | 110 | 130 (rozklad) |
| GeH4 | –165 | –88,1 |
| GeO2 | 1116 | – |
| H2 | –259,2 | –252,76 |
| H2O | 0 | 100 |
| H2O2 | –0,43 | 150,2 |
| H2S | –85,5 | –59,55 |
| H2S2 | – | 70,7 |
| H2Se | –65,73 | –41,25 |
| H2SO4 | 10,31 | 337 |
| H2SO5 | 45 (rozklad) | ‒ |
| H2Te | –49 | –2 |
| H3PO2 | 26,5 | 130 |
| H3PO3 | 74,4 | 200 |
| H3PO4 | 42,4 | 407 |
| HBr | –86,8 | –66,38 |
| HCl | –114,17 | –85 |
| HClO4 | –112 | ≈90 (rozklad) |
| HCN | –13,29 | 26 |
| He | –272,1 | –268,94 |
| HF | –83 | 20 |
| Hg | ‒38,83 | 356,62 |
| HgCl2 | 277 | 304 |
| HgO | 500 (rozklad) | ‒ |
| HI | –50,76 | –35,55 |
| HN3 | –80 | 35,7 |
| HNO3 | ‒41,6 | 83 |
| I2 | 113,7 | 184,4 |
| In | 156,6 | 2027 |
| K | 63,7 | 759 |
| K2CO3 | 899 | rozklad |
| K2O | 740 | ‒ |
| K2S | 948 | ‒ |
| KBr | 734 | 1435 |
| KCl | 771 | 1500 |
| KClO3 | 357 | rozklad |
| KClO4 | 610 (rozklad pri 400 °C) | – |
| KF | 858 | 1502 |
| KH | 619 | – |
| KHF2 | 238,8 | ‒ |
| KI | 681 | 1323 |
| KNO3 | 334 | 400 (rozklad) |
| KO2 | 380 | rozklad |
| KOH | 406 | 1327 |
| Kr | –157,4 (73,2kPa) | –153,2 |
| KrF2 | ≈25 (rozklad) | ‒ |
| La | 920 | 3464 |
| Li | 180,5 | 1342 |
| Li2O | 1438 | – |
| LiBr | 550 | ≈1300 |
| LiCl | 610 | 1383 (rozklad) |
| LiF | 848,2 | 1673 (rozklad) |
| LiH | 692 | – |
| Mg | 650 | 1090 |
| MgCl2 | 714 | 1412 |
| MgF2 | 1263 | 2227 |
| MgH2 | 327 | – |
| MgO | 2825 | 3600 |
| N2 | –210,0 | –195,8 |
| N2H4 | 1,54 | 113,55 |
| N2O | –90,8 | –88,48 |
| N2O3 | ‒101,1 | 3 (rozklad) |
| N2O4 | –9,3 | 21,15 |
| N2O5 | 30 | 47 |
| Na | 97,8 | 883 |
| Na2O | 1134 | 1950 (rozklad) |
| Na2O2 | 675 | rozklad |
| Na2S | 1172 | ‒ |
| NaBr | 747 | 1396 |
| NaCl | 801 | 1465 |
| NaF | 996 | 1704 |
| NaH | 425 (rozklad) | – |
| NaI | 661 | 1304 |
| NCl3 | –40 | 71 |
| Ne | –248,6 (43kPa) | –246,08 |
| NF3 | –206,79 | –128,75 |
| NH2OH | 33,1 | 58 |
| NH3 | –77,73 | –33,33 |
| NO | –163,6 | –151,74 |
| *n*–Si4H10 | –89,9 | 108,1 |
| O2 | –218,79 | –182,95 |
| O3 | –193 | –111,35 |
| OF2 | –224 | –145 |
| P4 | 44,2 | 280,5 |
| P4O10 | 562 | 605 |
| P4O6 | 23,8 | 175,4 |
| P4S3 | 173 | 407 |
| Pb | 327,46 | 1749 |
| PbBr2 | 371 | 892 |
| PbCl2 | 501 | 951 |
| PbCl4 | –15 | ≈50 (rozklad) |
| PbF2 | 830 | 1293 |
| PbF4 | 600 | – |
| PbH4 | – | –13 |
| PbO | 887 | ‒ |
| PbO2 | 290 (rozklad) | – |
| PBr3 | –41 | 175 |
| PbS | 1113 | – |
| PCl3 | –112 | 76 |
| PF3 | –151,5 | –101,8 |
| PF5 | –93,8 | –84,6 |
| PH3 | –133,8 | –87,75 |
| Po | 254 | 962 |
| Rb | 39,5 | 688 |
| RbH | 170 (rozklad) | – |
| RbOH | 301 | 1390 |
| Rn | –71 | –61,6 |
| S2Cl2 | ‒77 | 137 |
| S8 (monoklinická) | 115,21 | 444,61 |
| S8 (rombická) | 95,3 (premena na monokl.) | 444,61 |
| Sb | 630,6 | 1587 |
| SbF5 | 8,3 | 141 |
| SbH3 | –88 | –17 |
| Sc | 1541 | 2836 |
| Sc2O3 | 2485 | – |
| SCl2 | ‒122 | 59,6 |
| SeF6 | –34,6 | –46,6 |
| SF4 | –125 | –40,45 |
| SF6 | –49,6 | –63,8 (sublimácia) |
| Si | 1414 | 3265 |
| Si2H6 | –129,4 | –14,8 |
| Si3H8 | –117,4 | 52,9 |
| SiCl4 | –68,74 | 57,65 |
| SiF4 | –90,2 | –86 |
| SiH4 | –185 | –111,9 |
| SiHCl3 | –128,2 | 33 |
| SiO2 (kristobalit) | 1722 | 2950 |
| SiO2 (tridymit) | 1470 (premena na kristobalit) | 2950 |
| SiO2 (α-kremeň) | 573 (premena na β-kremeň) | 2950 |
| SiO2 (β-kremeň) | 867 (premena na tridymit) | 2950 |
| Sn (biely) | 231,9 | 2586 |
| Sn (šedý) | 13,2 (premena na biely Sn) | 2586 |
| SnCl2 | 246,8 | 623 |
| SnCl4 | –33,3 | 114,1 |
| SnH4 | –146 | –51,8 |
| SnO | 1080 (rozklad) | – |
| SnO2 | 1630 | 1900 |
| SO2 | –75,5 | –10,05 |
| SO3 (γ–forma) | 16,8 | 44,5 |
| Sr | 777 | 1382 |
| SrH2 | 1050 |  |
| SrO | 2531 | 3200 |
| T2 | –252,53 | –248,11 |
| T2O | 4,48 | 101,51 |
| Te | 449,5 | 988 |
| TeO2 | 733 | 1245 |
| Tl | 304 | 1473 |
| Xe | –111,8 (81,6kPa) | –108,1 |
| XeF2 | 129,03 | 114,4 (sublimácia) |
| XeF4 | 117,1 | 115,8 (sublimácia) |
| XeF6 | 49,48 | 75,6 |
| XeO3 | 25 (explozívny) | – |
| Y | 1522 | 3345 |
| Y2O3 | 2439 | – |
| Zn | 419,53 | 907 |
| ZnO | 1974 | ‒ |
| ZnS (sfalerit) | 1020 (premena na wurtzit) | ‒ |
| ZnS (wurtzit) | 1710 | sublimácia |
| Zr | 1854,7 | 4409 |
| ZrO2 | 2710 | ‒ |

Príloha 12 – Termodynamické parametre

Prezentované štandardné termodynamické parametre Δf*H*, Δf*G* a *S* vybraných zlúčenín sú prevzaté z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010, alebo Silberberg, M. S.: *Principles of General chemistry*, 2nd ed., McGraw-Hill Companies, Inc., New York, USA 2010. Uvedené termodynamické hodnoty sú experimentálne, stanovené za štandardných podmienok pri 25 °C.

| Zlúčenina | Δf*H* / kJ mol–1 | Δf*G* / kJ mol–1 | *S* / J K–1 mol–1 |
| --- | --- | --- | --- |
| Al(s) | 0 | 0 | 28,3 |
| Al2O3(s) | –1676 | –1582 | 50,94 |
| Al3+(aq) | –524,7 | –481,2 | –313 |
| AlCl3(s) | –704,2 | –628,9 | 110,7 |
| Ar(g) | 0 | 0 | 154,73 |
| As(s, šedý) | 0 | 0 | 35,1 |
| As2(g) | 222,2 | 171,9 | 239,4 |
| As2O5(s) | –924,9 | –782,3 | 105,4 |
| As2S3(s) | –169,0 | –168,6 | 163,6 |
| AsCl3(l) | –305,0 | –259,4 | 216,3 |
| AsF3(g) | –785,8 | –770,8 | 289,1 |
| AsF3(l) | –821,3 | –774,2 | 181,2 |
| AsH3(g) | 66,4 | 68,9 | 222,8 |
| AsI3(s) | –58,2 | –59,4 | 213,1 |
| B(g) | 565 | 521 | 153 |
| B(s, β-romboédrický) | 0 | 0 | 5,87 |
| B2H6(g) | 35 | 86,6 | 232,0 |
| B2O3(s) | –1272 | –1193 | 53,8 |
| B4H10(g) | 66,1 | 184,3 | 280,3 |
| B5H11(l) | 73,2 | – | – |
| B5H9(l) | 42,7 | 171,8 | 184,2 |
| B6H10(l) | 56,3 | – | – |
| BCl3(g) | –1137 | –1120,3 | 254 |
| BF3(g) | –403,8 | –388,7 | 290 |
| Bi(s) | 0 | 0 | 56,7 |
| Bi2O3(s) | –573,9 | –493,7 | 151,5 |
| Bi2S3(s) | –143,1 | –140,6 | 200,4 |
| BiCl3(s) | –379,1 | –315,0 | 177,0 |
| BiH3(g) | 277,8 | – | – |
| Br–(aq) | –120,9 | –102,82 | 80,71 |
| Br(g) | 111,9 | 82,40 | 174,90 |
| Br–(g) | –218,9 | – | – |
| Br2(aq) | 30,91 | 3,13 | 245,38 |
| Br2(l) | 0 | 0 | 152,23 |
| BrO3‒(aq) | ‒67,07 | 18,60 | 161,71 |
| C(diamant) | 1,896 | 2,866 | 2,439 |
| C(g) | 716,7 | 671,3 | 158,1 |
| C(grafit) | 0 | 0 | 5,686 |
| C2H2(g) | 227 | 209 | 200,85 |
| C2H4(g) | 52,47 | 68,36 | 219,22 |
| C2H6(g) | –84,67 | –32,89 | 229,5 |
| Ca(OH)2(s) | –985,2 | –897,5 | 83,4 |
| Ca(s) | 0 | 0 | 41,6 |
| Ca2+(aq) | –543 | –553 | –56 |
| Ca3(PO4)2(s) | –4120,8 | –3884,7 | 236,0 |
| CaC2(s) | –60 | –65 | 70 |
| CaCl2(s) | –795,4 | –748,8 | 108,4 |
| CaCO3(s. kalcit) | –1207 | –1129 | 93 |
| CaO(s) | –634,9 | –603,3 | 38,1 |
| CaSO4(s) | –1434,5 | –1322,0 | 106,5 |
| CH3Cl(l) | –132 | –71,5 | 203 |
| CH4(g) | –74,81 | –50,72 | 186,26 |
| Cl–(aq) | –167,46 | –131,17 | 55,1 |
| Cl(g) | 121 | 105 | 165,1 |
| Cl–(g) | –234 | –240 | 153,25 |
| Cl2(g) | 0 | 0 | 223 |
| Cl2O7(l) | 272 | > 270 |  |
| ClO–(aq) | –107,1 | –36,8 | 42 |
| ClO2–(aq) | –66,5 | 17,2 | 101,3 |
| ClO2(g) | 102 | 120 | 256,7 |
| ClO3–(aq) | –103,97 | –7,95 | 162,3 |
| ClO4–(aq) | –129,33 | –8,52 | 182 |
| CO(g) | –110,53 | –137,17 | 197,67 |
| CO2(aq) | –412,9 | –386,2 | 121 |
| CO2(g) | –393,51 | –394,37 | 213,79 |
| CO32–(aq) | –676,26 | –528,1 | –53,1 |
| CS2(l) | 89 | 64,6 | 151,3 |
| CSe2(l) | 164,8 |  |  |
| F–(aq) | –329,1 | –276,5 | –9,6 |
| F(g) | 78,9 | 61,8 | 158,64 |
| F–(g) | –255,6 | –262,5 | 145,47 |
| F2(g) | 0 | 0 | 202,7 |
| Ga(OH)3(s) | –964,4 | –831,3 | 100,0 |
| Ga(s) | 0 | 0 | 40,8 |
| Ga2O3(s) | –1089,1 | –998,3 | 85,0 |
| GaCl3(g) | –524,7 | –454,8 | 142 |
| GaF3(s) | –1163,0 | –1085,3 | 84,0 |
| Ge(s) | 0 | 0 | 31,1 |
| GeCl4(l) | –531,8 | –462,7 | 245,6 |
| GeF4(g) | –1190,2 | –1150,0 | 301,9 |
| GeH4(g) | 90,8 | 113,4 | 217,1 |
| GeI4(s) | –141,8 | –144,3 | 271,1 |
| GeO(s) | –261,9 | –237,2 | 50,0 |
| GeO2(s) | –580,0 | –521,4 | 39,7 |
| H(g) | 217,96 | 203,26 | 114,6 |
| H+(aq) | 0 | 0 | 0 |
| H+(g) | 1536,3 | 1517,1 | 108,83 |
| H2(g) | 0 | 0 | 130,68 |
| H2CO3(aq) | –698,7 | –623,42 | 191 |
| H2O(g) | –241,82 | –228,57 | 188,83 |
| H2O(l) | –285,84 | –237,192 | 69,94 |
| H2O2(aq) | –191,17 | –134,03 | 143,9 |
| H2O2(l) | –187,78 | –120,42 | 109,6 |
| H2PO4–(aq) | –1285 | –1135 | 89,1 |
| H2S(aq) | –39 | –27,4 | 122 |
| H2S(g) | –20,6 | –33,4 | 205,8 |
| H2Se(g) | 29,7 | 15,9 | 219 |
| H2SeO4(s) | ‒530,1 |  |  |
| H2SO3(aq) | ‒608,81 | ‒537,81 | 232,2 |
| H2SO4(aq) | –907,51 | –741,99 | 17 |
| H2SO4(l) | –813,99 | –690,06 | 156,9 |
| H2Te(g) | 99,6 | – | – |
| H3BO3(s) | –1094,3 | –969,01 | 88,83 |
| H3O+(aq) | –285,83 | –237,18 | 69,91 |
| H3PO4(aq) | –1277 | –1019 | 228 |
| HBr(g) | –36,3 | –53,5 | 198,59 |
| HCl(aq) | –167,46 | –131,17 | 55,06 |
| HCl(g) | –92,31 | –95,3 | 186,79 |
| HClO(aq) | –120,9 | –79,9 | 142 |
| HCO3–(aq) | –691,11 | –587,06 | 95 |
| He(g) | 0 | 0 | 126,04 |
| HF(g) | –273 | –275 | 173,67 |
| HI(g) | 26,5 | 1,70 | 206,6 |
| HNO2(g) | –79,5 | –46,0 | 254 |
| HNO3(g) | –133,9 | –73,5 | 266,9 |
| HNO3(l) | –174,1 | –80,7 | 155,6 |
| HPO42–(aq) | –1281 | –1082 | –36 |
| HS–(aq) | –17,7 | 12,6 | 61,1 |
| HSO3‒(aq) | ‒626,22 | ‒527,73 | 139,7 |
| HSO4–(aq) | –885,75 | –752,87 | 126,9 |
| I–(aq) | –55,94 | –51,67 | 109,4 |
| I(g) | 106,8 | 70,21 | 180,67 |
| I–(g) | –194,7 | – | – |
| I2(g) | 62,442 | 19,38 | 260,58 |
| I2(s) | 0 | 0 | 116,14 |
| I2O5(s) | –151,8 | – | – |
| I3–(aq) | –51,5 | –51,4 | 239,3 |
| IBr(g) | 40,84 | 3,71 | 258,66 |
| ICl(g) | 17,78 | –5,44 | 247,44 |
| IF(g) | –95,7 | –118,5 | 236,2 |
| IF(s) | –95,4 |  |  |
| IF5(g) | –822,5 | –751,7 | 327,7 |
| IF5(l) | –885 | –784 |  |
| In(s) | 0 | 0 | 57,8 |
| In2O3(s) | –925,8 | –830,7 | 104,2 |
| InSb(s) | –30,5 | –25,5 | 86,2 |
| Kr(g) | 0 | 0 | 163,97 |
| N(g) | 473 | 456 | 153,2 |
| N2(g) | 0 | 0 | 191,5 |
| N2H4(l) | 50,63 | 149,2 | 121,2 |
| N2O(g) | 82,05 | 104,2 | 219,7 |
| N2O3(g) | 86,6 | 142,4 | 314,7 |
| N2O3(l) | 50,3 | ‒ | ‒ |
| N2O4(g) | 9,16 | 97,7 | 304,3 |
| N2O4(g) | 9,16 | 97,7 | 304,3 |
| N2O5(g) | 11 | 118 | 346 |
| N2O5(g) | 13,3 | 117,1 | 355,7 |
| N2O5(s) | –43,1 | 113 | 178 |
| NCl3(l) | – | 230,0 | – |
| Ne(g) | 0 | 0 | 146,22 |
| NF3(g) | –132,1 | –90,6 | 260,8 |
| NH3(aq) | –80,83 | 26,7 | 110 |
| NH3(g) | –45,9 | –16 | 193 |
| NH4Cl(s) | –314,4 | –203 | 94,6 |
| NH4ClO4(s) | –296 | – | – |
| NO(g) | 90,29 | 86,60 | 210,65 |
| NO2–(aq) | –105 | –32 | 123 |
| NO2(g) | 33,2 | 51 | 239,9 |
| NO3–(aq) | –207 | –111 | 147 |
| O(g) | 249,2 | 231,7 | 160,95 |
| O2(g) | 0 | 0 | 205 |
| O2F2(g) | 19,2 | 58,2 | 277,2 |
| O3(g) | 143 | 163,2 | 238,82 |
| OF2(g) | 24,5 | 41,8 | 247,5 |
| OH–(aq) | –229,99 | –157,24 | –10,75 |
| P(g) | 314,6 | 278,3 | 163,1 |
| P(s, červený) | –17,6 | –12,1 | 22,8 |
| P(s,čierny) | –39,3 | – | – |
| P4(g) | 58,9 | 24,5 | 280 |
| P4(s, biely) | 0 | 0 | 41,1 |
| P4O10(s) | –2984 | –2698 | 229 |
| Pb(s) | 0 | 0 | 64,8 |
| PbBr2(s) | –278,7 | –261,9 | 161,5 |
| PbCl2(s) | –359,4 | –314,1 | 136,0 |
| PbF2(s) | –664,0 | –617,1 | 110,5 |
| PbI2(s) | –175,5 | –173,6 | 174,9 |
| PbO(s, masikot) | –217,3 | –187,9 | 68,7 |
| PbO2(s) | –277,4 | –217,3 | 68,6 |
| PbS(s) | –100,4 | –98,7 | 91,2 |
| PCl3(g) | –287 | –268 | 312 |
| PCl3(l) | –320 | –272 | 217 |
| PCl5(g) | –402 | –323 | 353 |
| PCl5(s) | –443,5 | – | – |
| PF3(g) | –958,4 | –936,9 | 273,1 |
| PH3(g) | 5,4 | 13,5 | 210,2 |
| PO43–(aq) | –1266 | –1013 | –218 |
| S(g) | 277,2 | 236,7 | 168 |
| S(s, monoklinická) | 0,3 | 0,096 | 32,6 |
| S(s, rombická) | 0 | 0 | 31,9 |
| S2–(aq) | 41,8 | 83,7 | 22 |
| S2(g) | 129 | 80,1 | 228,1 |
| S8(g) | 101 | 49,1 | 430,21 |
| (SO3)3(s) | –454,5 | –374,2 | 70,7 |
| Sb(s) | 0 | 0 | 45,7 |
| Sb2(g) | 235,6 | 187,0 | 254,9 |
| Sb2O5(s) | –971,9 | –829,2 | 125,1 |
| SbBr3(s | –259,4 | –239,3 | 207,1 |
| SbCl3(s) | –382,2 | –323,7 | 184,1 |
| SbF3(s) | –915,5 | – | – |
| SbH3(g) | 145,1 | 147,8 | 232,8 |
| Se(g) | 227,07 | 187,06 | 176,61 |
| Se(s, šedý) | 0 | 0 | 42,44 |
| Se(s, α-forma) | 6,7 | ‒ | ‒ |
| Se2(g) | 146 | 96,2 | 252 |
| SeF6(s) | ‒1117 | ‒1017 | 313,9 |
| SeO2(s) | ‒225,4 |  |  |
| SF4(g) | ‒763,2 | ‒722 | 299,6 |
| SF6(g) | ‒1209 | ‒1105,4 | 291,71 |
| Si(s) | 0 | 0 | 18 |
| SiC(s) | –65 | –63 | 17 |
| SiCl4(l) | –687 | –620 | 240 |
| SiF4(g) | –1614,9 | –1572,7 | 282,4 |
| SiH4(g) | 34,3 | 56,9 | 204,6 |
| SiO2(s) | –910,9 | –856,5 | 41,5 |
| SiO2(s, kremeň) | –910,9 | –856,5 | 41,5 |
| Sn(OH)2(s) | –561 | –492 | 155 |
| Sn(s, biely) | 0 | 0 | 51,5 |
| Sn(s, šedý) | 3 | 4,6 | 44,8 |
| SnCl2(s) | –331 | –289 | 132 |
| SnCl4(l) | –545,2 | –474 | 259 |
| SnH4 | 163 | 188 | 228 |
| SnO(s) | –285 | –257 | 56 |
| SnO2(s) | –581 | –520 | 52 |
| SO2(g) | –296,8 | –300,2 | 248,1 |
| SO3(g) | –395,7 | –371,1 | 256,8 |
| SO3(l) | –441 | –373,1 | 113,8 |
| SO32‒(aq) | ‒635,5 | ‒486,5 | ‒29 |
| SO42–(aq) | –907,51 | –741,99 | 17 |
| Te(g) | 196,7 | 157,1 | 182,7 |
| Te2(g) | 168,2 | 118 | 268,1 |
| TeCl4(s) | ‒326,4 | ‒ | ‒ |
| TeF6(g) | ‒1318 | ‒ | ‒ |
| TeO2(s) | ‒322,6 | ‒515,8 | 49 |
| Tl(s) | 0 | 0 | 64,2 |
| TlI(s) | –123,8 | –125,4 | 127,6 |
| TlOH(s) | –238,9 | –195,8 | 88,0 |
| Xe(g) | 0 | 0 | 169,57 |
| XeF2(g) | –130 | –96 | 260 |
| XeF4(g) | –215 | –138 | 316 |
| XeF6(g) | –338 | – | – |
| XeO3(s) | 502 | 561 | 287 |

Príloha 13 – Štandardné tvorné a rozpušťacie entalpie

Štandardné tvorné entalpie vybraných tuhých iónových zlúčenín Δf*H*(MX(s)), ich vodných roztokov Δf*H*(MX(aq, *c* = 1 mol dm−3) a vypočítané hodnoty rozpúšťacích entalpií Δrozp*H*(MX) sú prevzaté z Kotz J. C., Treichel P. M., Townsend J. R., Treichel D. A.: *Chemistry & Chemical Reactivity*, 9th ed., Cengage Learning, Stamford, USA 2015.

MX(s)  MX(aq)

|  |  |  |  |
| --- | --- | --- | --- |
| Zlúčenina | Δf*H*(MX(s)) / kJ mol−1 | Δf*H*(MX(aq)) / kJ mol−1 | Δrozp*H*(MX(aq)) / kJ mol−1 |
| KCl | −436,7 | −419,5 | 17,2 |
| KF | −568,6 | −585,0 | −16,4 |
| LiCl | −408,7 | −445,6 | −36,9 |
| LiF | −616,9 | −611,1 | 5,8 |
| NaF | −573,6 | −572,8 | 0,8 |
| NaCl | −411,1 | −407,2 | 3,9 |
| NaOH | −425,9 | −469,2 | −43,3 |
| NH4NO3 | −356,6 | −339,9 | 16,7 |
| RbCl | −435,4 | −418,3 | 17,1 |
| RbF | −557,7 | −583,8 | −26,1 |

Príloha 14 – Štandardné hydratačné entalpie

Štandardné hydratačné entalpie Δhydr*H* častíc A*q* sú prevzaté z D. W. Smith: *J. Chem.* *Educ.,* 54 (1977) 540 alebo W. G. van der Slyus: *J. Chem.* *Educ.,* 78 (2001) 111 alebo D. R. Lide (ed.):
*CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

|  |  |  |  |
| --- | --- | --- | --- |
| Častica A*q* | Δhydr*H*(A*q*) / kJ mol−1 | Častica A*q* | Δhydr*H*(A*q*) / kJ mol−1 |
| Ag+ | –510 | I– | –295 |
| Al3+ | –4665 | In3+ | –4168 |
| Ba2+ | –1305 | K+ | –322 |
| Be2+ | –2494 | Li+ | –520 |
| Br– | –336 | Mg2+ | –1921 |
| Ca2+ | –1577 | Mn2+ | –1841 |
| Cd2+ | –1807 | Na+ | –406 |
| CH4(g) | –12,0 | Ne(g) | –3,90 |
| Cl– | –363 | NH3(g) | –35,4 |
| ClO4– | –238 | Ni2+ | –2105 |
| CO2(g) | –17,9 | NO2– | –383 |
| Co2+ | –1996 | NO3– | –370 |
| Cr2+ | –1904 | O2(g) | –1,20 |
| Cs+ | –276 | OH– | –510 |
| Cu2+ | –2100 | Rb+ | –297 |
| F– | –505 | SF6(g) | –20,7 |
| Fe2+ | –1949 | SO42– | –1059 |
| Fe3+ | –4430 | Sr2+ | –1443 |
| Ga3+ | –4708 | Tl+ | –326 |
| H+ | –1130 | Tl3+ | –4119 |
| He(g) | –0,67 | Zn2+ | –2046 |
| Hg2+ | –1824 |  |  |

Príloha 15 – Autoprotolytické konštanty rozpušťadiel

Autoprotolytické konštanty *K*ap rozpúšťadiel SH pri 25 °C sú prevzaté z Miessler G. L., Fischer P. J., Tarr D. A.: *Inorganic chemistry*, 5th ed., Pearson, USA 2014.

2 SH(l)  SH2+(aq) + S–(aq)

|  |  |
| --- | --- |
| Rovnováha | *K*ap |
| CH3CN(l) + CH3CN(l)  CH3CNH+(solv) + CH2CN–(solv) | 4,0 . 10–35 |
| CH3COOH(l) + CH3COOH(l)  CH3COOH2+(solv) + CH3COO–(solv) | 3,5 . 10–15 |
| CH3OH(l) + CH3OH(l)  CH3OH2+(solv) + CH3O–(solv) | 2,5 . 10–17 |
| H2O(l) + H2O(l)  H3O+(aq) + OH–(aq) | 1,0 . 10–14 |
| H2SO4(l) + H2SO4(l)  H3SO4+(solv) + HSO4–(solv) | 4,0 . 10–4 \* |
| HF(l) + HF(l)  H2F+(solv) + F–(solv) | 1 . 10–12 \*\* |
| NH3(l) + NH3(l)  NH4+(solv) + NH2–(solv) | 1 . 10–27 \*\*\* |

\* Pri 10 °C, \*\* pri 0 °C, \*\*\* pri –60 °C.

Príloha 16 – Autoprotolytické konštanty vody

Autoprotolytické konštanty *K*v (p*K*v) vody v závislosti od teploty sú prevzaté z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010.

2 H2O(l)  H3O+(aq) + OH–(aq)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Teplota | 0 °C | 20 °C | 25 °C | 30 °C | 50 °C | 100 °C |
| *K*v | 1,12 . 10–15 | 6,76 . 10–15 | 1,02 . 10–14 | 1,47 . 10–14 | 5,48 .10–14 | 3,00 . 10–13 |
| p*K*v | 14,95 | 14,17 | 13,99 | 13,83 | 13,26 | 12,52 |
| pH | 7,47 | 7,08 | 7,00 | 6,92 | 6,63 | 6,26 |

Príloha 17 – Ionizačné konštanty kyselín

Ionizačné konštanty *K*k (p*K*k) kyselín HA vo vode pri 25 °C sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011.

HA(aq) + H2O(l)  H3O+(aq) + A–(aq)

| Reakcia ionizácie | *K*k | p*K*k |
| --- | --- | --- |
| ***Silné kyseliny*** |  |  |
| H2SeO4(aq) + H2O(l)  HSeO4–(aq) + H3O+(aq) | 103 | –3 |
| H2SO4(aq) + H2O(l)  HSO4–(aq) + H3O+(aq) | 103 | –3 |
| H3O+(aq) + H2O(l)  H2O(l) + H3O+(aq) | 1 | 0 |
| HBr(aq) + H2O(l)  Br–(aq) + H3O+(aq) | 109 | –9 |
| HCl(aq) + H2O(l)  Cl–(aq) + H3O+(aq) | 107 | –7 |
| HClO3(aq) + H2O(l)  ClO3–(aq) + H3O+(aq) | 103 | –3 |
| HClO4 (aq) + H2O(l)  ClO4–(aq) + H3O+(aq) | 1010 | –10 |
| HI(aq) + H2O(l)  I–(aq) + H3O+(aq) | 1011 | –11 |
| HNO3(aq) + H2O(l)  NO3–(aq) + H3O+(aq) | 5,4.101 | –1,7 |
| ***Slabé kyseliny*** |  |  |
| C6H5COOH(aq) + H2O(l)  C6H5COO–(aq) + H3O+(aq) | 6,3.10–5 | 4,20 |
| CCl3COOH(aq) + H2O(l)  CCl3COO–(aq) + H3O+(aq) | 2.10–1 | 0,70 |
| CH2(Cl)COOH(aq) + H2O(l)  CH2(Cl)COO–(aq) + H3O+(aq) | 1,3.10–3 | 2,87 |
| CH3CH(Cl)COOH(aq) + H2O(l)  CH3CH(Cl)COO–(aq) + H3O+(aq) | 1,5.10–3 | 2,83 |
| CH3CH2COOH(aq) + H2O(l)  CH3CH2COOH –(aq) + H3O+(aq) | 1,3.10–5 | 4,87 |
| CH3CH2OH(aq) + H2O(l)  CH3CH2O–(aq) + H3O+(aq) | 3,2.10–16 | 15,5 |
| CH3COOH(aq) + H2O(l)  CH3COO–(aq) + H3O+(aq) | 1,7.10–5 | 4,76 |
| Cl(CH2)2COOH(aq) + H2O(l)  Cl(CH2)2COO–(aq) + H3O+(aq) | 1,0.10–4 | 3,98 |
| H2AsO4–(aq) + H2O(l)  HAsO42–(aq) + H3O+(aq) | 1,7.10–7 | 6,76 |
| H2CO3(aq) + H2O(l)  HCO3–(aq) + H3O+(aq) | 4,5.10–7 | 6,35 |
| H2CrO4(aq) + H2O(l)  HCrO4–(aq) + H3O+(aq) | 1,8.10–1 | 0,74 |
| H2O2(aq) + H2O(l)  HO2–(aq) + H3O+(aq) | 2,4.10–12 | 11,62 |
| H2PO3–(aq) + H2O(l)  HPO32–(aq) + H3O+(aq) | 2,0.10–7 | 6,70 |
| H2PO4–(aq) + H2O(l)  HPO42–(aq) + H3O+(aq) | 6,2.10–8 | 7,21 |
| H2S(aq) + H2O(l)  HS–(aq) + H3O+(aq) | 8,9.10–8 | 7,05 |
| H2Se(aq) + H2O(l)  HSe–(aq) + H3O+(aq) | 1,3.10–4 | 3,89 |
| H2SeO3(aq) + H2O(l)  HSeO3–(aq) + H3O+(aq) | 2,4.10–3 | 2,62 |
| H2SO3(aq) + H2O(l)  HSO3–(aq) + H3O+(aq) | 1,4.10–2 | 1,85 |
| H2Te(aq) + H2O(l)  HTe–(aq) + H3O+(aq) | 2,5.10–3 | 2,6 |
| H2TeO3(aq) + H2O(l)  HTeO3–(aq) + H3O+(aq) | 5,4.10–7 | 6,27 |
| H2TeO4(aq) + H2O(l)  HTeO4–(aq) + H3O+(aq) | 2,1.10–8 | 7,68 |
| H3AsO2–(aq) + H2O(l)  HAsO32–(aq) + H3O+(aq) | 3,0.10–14 | 13,52 |
| H3AsO3(aq) + H2O(l)  H2AsO3–(aq) + H3O+(aq) | 5,5.10–10 | 9,22 |
| H3AsO4(aq) + H2O(l)  H2AsO4–(aq) + H3O+(aq) | 5,5.10–3 | 2,26 |
| H3BO3(aq) + H2O(l)  H2BO3–(aq) + H3O+(aq) | 5,4.10–10 | 9,27 |
| H3PO2(aq) + H2O(l)  H2PO3–(aq) + H3O+(aq) | 7,9.10–2 | 1,10 |
| H3PO3(aq) + H2O(l)  H2PO2–(aq) + H3O+(aq) | 5,0.10–2 | 1,3 |
| H3PO4(aq) + H2O(l)  H2PO4–(aq) + H3O+(aq) | 6,9.10–3 | 2,16 |
| H3SbO4(aq) + H2O(l)  H2SbO4–(aq) + H3O+(aq) | 4.10–5 | 4,40 |
| HAsO42–(aq) + H2O(l)  AsO43–(aq) + H3O+(aq) | 5,1.10–12 | 11,29 |
| HBrO(aq) + H2O(l)  BrO–(aq) + H3O+(aq) | 2,8.10–9 | 8,55 |
| HBrO3(aq) + H2O(l)  BrO3–(aq) + H3O+(aq) | 2.10–1 | 0,70 |
| HClO(aq) + H2O(l)  ClO–(aq) + H3O+(aq) | 4,0.10–8 | 7,40 |
| HClO2(aq) + H2O(l)  ClO2–(aq) + H3O+(aq) | 1,1.10–2 | 1,96 |
| HCN(aq) + H2O(l)  CN–(aq) + H3O+(aq) | 6,2.10–10 | 9,21 |
| HCO3–(aq) + H2O(l)  CO32–(aq) + H3O+(aq) | 4,7.10–11 | 10,33 |
| HCOOH(aq) + H2O(l)  HCOO–(aq) + H3O+(aq) | 1,8.10–4 | 3,75 |
| HCrO4–(aq) + H2O(l)  CrO42–(aq) + H3O+(aq) | 3,2.10–7 | 6,49 |
| HF(aq) + H2O(l)  F–(aq) + H3O+(aq) | 3,5.10–4 | 3,46 |
| HIO(aq) + H2O(l)  IO–(aq) + H3O+(aq) | 3,2.10–13 | 10,5 |
| HIO3(aq) + H2O(l)  IO3–(aq) + H3O+(aq) | 1,7.10–1 | 0,78 |
| HIO4(aq) + H2O(l)  IO4–(aq) + H3O+(aq) | 2,3.10–2 | 1,64 |
| HMnO4(aq) + H2O(l)  MnO4–(aq) + H3O+(aq) | 1,78.10–2 | 1,75 |
| HN3(aq) + H2O(l)  N3–(aq) + H3O+(aq) | 2,5.10–5 | 4,6 |
| HNCO(aq) + H2O(l)  NCO–(aq) + H3O+(aq) | 3,5.10–4 | 3,46 |
| HNO2(aq) + H2O(l)  NO2–(aq) + H3O+(aq) | 5,6.10–4 | 3,25 |
| HPO42–(aq) + H2O(l)  PO43–(aq) + H3O+(aq) | 4,8.10–13 | 12,32 |
| HS–(aq) + H2O(l)  S2–(aq) + H3O+(aq) | 1,1.10–12 | 11,96 |
| HSe–(aq) + H2O(l)  Se2–(aq) + H3O+(aq) | 10–11 | 11,00 |
| HSeO3–(aq) + H2O(l)  SeO32–(aq) + H3O+(aq) | 4,8.10–9 | 8,32 |
| HSeO4–(aq) + H2O(l)  SeO42–(aq) + H3O+(aq) | 2,0.10–2 | 1,7 |
| HSO3–(aq) + H2O(l)  SO32–(aq) + H3O+(aq) | 6,3.10–8 | 7,20 |
| HSO4–(aq) + H2O(l)  SO42–(aq) + H3O+(aq) | 1,0.10–2 | 2,00 |
| HTeO3–(aq) + H2O(l)  TeO32–(aq) + H3O+(aq) | 3,7.10–9 | 8,43 |
| NH4+(aq) + H2O(l)  NH3(aq) + H3O+(aq) | 5,6.10–10 | 9,25 |

Príloha 18 – Ionizačné konštanty akvakomplexov katiónov kovov

Ionizačné konštanty *K*k (p*K*k) akvakomplexov katiónov kovov [M(H2O)*x*]*n*+ vo vode pri 25 °C sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011 alebo z Petrucci R. H., Herring F. G., Madura J. D., Bissonnette C.: *General chemistry*, 8th ed., Pearson, USA 2017.

[M(H2O)*x*]*n*+(aq) + H2O(l)  [M(H2O)*x*](*n*–1)+(aq) + H3O+(aq)

|  |  |  |
| --- | --- | --- |
| Reakcia ionizácie | *K*k | p*K*k |
| [Al(H2O)6]3+(aq) + H2O(l)  [Al(H2O)5(OH)]2+(aq) + H3O+(aq) | 7,6 . 10–6 | 5,12 |
| [Be(H2O)4]2+(aq) + H2O(l)  [Be(H2O)3(OH)]+(aq) + H3O+(aq) | 3,2 . 10–7 | 6,50 |
| [Cd(H2O)6]2+(aq) + H2O(l)  [Cd(H2O)5(OH)]+(aq) + H3O+(aq) | 2,0 . 10–12 \* | 11,7 |
| [Co(H2O)6]2+(aq) + H2O(l)  [Co(H2O)5(OH)]+(aq) + H3O+(aq) | 2,5 . 10–10 | 9,60 |
| [Cr(H2O)6]3+(aq) + H2O(l)  [Cr(H2O)5(OH)]2+(aq) + H3O+(aq) | 1,0 . 10–5 | 5,00 |
| [Cu(H2O)6]2+(aq) + H2O(l)  [Cu(H2O)5(OH)]+(aq) + H3O+(aq) | 2,9 . 10–8 | 7,54 |
| [Fe(H2O)6]2+(aq) + H2O(l)  [Fe(H2O)5(OH)]+(aq) + H3O+(aq) | 7,9 . 10–11 | 10,1 |
| [Fe(H2O)6]3+(aq) + H2O(l)  [Fe(H2O)5(OH)]2+(aq) + H3O+(aq) | 6,5 . 10–3 | 2,19 |
| [Li(H2O)4]+(aq) + H2O(l)  [Li(H2O)3(OH)](aq) + H3O+(aq) | 1,5 . 10–14 \* | 13,8 |
| [Mg(H2O)6]2+(aq) + H2O(l)  [Mg(H2O)5(OH)]+(aq) + H3O+(aq) | 3,9 . 10–12 \* | 11,4 |
| [Mn(H2O)6]2+(aq) + H2O(l)  [Mn(H2O)5(OH)]+(aq) + H3O+(aq) | 2,0 . 10–11 | 10,7 |
| [Na(H2O)*x*]+(aq) + H2O(l)  [Na(H2O)*x*−1(OH)](aq) + H3O+(aq) | 1,6 . 10–15 \* | 14,8 |
| [Ni(H2O)6]2+(aq) + H2O(l)  [Cu(H2O)5(OH)]+(aq) + H3O+(aq) | 4,0 . 10–10 | 9,40 |
| [Pb(H2O)4]2+(aq) + H2O(l)  [Pb(H2O)3(OH)]+(aq) + H3O+(aq) | 1,7 . 10–8 | 7,77 |
| [Pu(H2O)*x*]4+(aq) + H2O(l)  [Pu(H2O)*x*−1(OH)]3+(aq) + H3O+(aq) | 2,5 . 10–2 | 1,60 |
| [Sc(H2O)6]3+(aq) + H2O(l)  [Sc(H2O)5(OH)]2+(aq) + H3O+(aq) | 2,5 . 10–5 | 4,60 |
| [V(H2O)6]3+(aq) + H2O(l)  [V(H2O)5(OH)]2+(aq) + H3O+(aq) | 1,2 . 10–3 | 2,92 |
| [Zn(H2O)6]2+(aq) + H2O(l)  [Zn(H2O)5(OH)]+(aq) + H3O+(aq) | 2,5 . 10–10 | 9,60 |

\* Extrémne malé hodnoty konštánt hydrolýzy niektorých akvatovaných katiónov kovov znamenajú, že ich hydrolýza prakticky neprebieha.

Príloha 19 – Ionizačné konštanty zásad

Ionizačné konštanty *K*z (p*K*z) zásad B vo vode pri 25 °C sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011 alebo *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010 alebo z Petrucci R. H., Herring F. G., Madura J. D., Bissonnette C.: *General chemistry*, 8th ed., Pearson, USA 2017.

B(aq) + H2O(l)  BH+(aq) + OH–(aq)

|  |  |  |  |
| --- | --- | --- | --- |
| Zásada | Reakcia ionizácie | *K*z | p*K*z |
| amoniak | NH3(aq) + H2O(l)  NH4+(aq) + OH–(aq) | 1,8 . 10–5 | 4,75 |
| anilín | C6H5NH2(aq) + H2O(l)  C6H5NH3+(aq) + OH–(aq) | 7,4 . 10–10 | 9,13 |
| brómamín | BrNH2(aq) + H2O(l)  BrNH3+(aq) + OH–(aq) | 2,5 . 10–8 | 7,61 |
| cyklohexylamín | C6H11NH2(aq) + H2O(l)  C6H11NH3+(aq) + OH–(aq) | 4,4 . 10–4 | 3,36 |
| dietylamin | (C2H5)2NH(aq) + H2O(l)  (C2H5)2NH2+(aq) + OH–(aq) | 6,9 . 10–4 | 3,16 |
| dimetylamín | (CH3)2NH(aq) + H2O(l)  (CH3)2NH2+(aq) + OH–(aq) | 5,4 . 10–4 | 3,27 |
| etylamín | C2H5NH2(aq) + H2O(l)  C2H5NH3+(aq) + OH–(aq) | 4,5 . 10–4 | 3,35 |
| hydrazín | N2H4(aq) + H2O(l)  N2H5+(aq) + OH–(aq) | 1,3 . 10–6 | 5,90 |
| hydroxylamín | HONH2 (aq) + H2O(l)  HONH3+(aq) + OH–(aq) | 8,7 . 10–9 | 8,06 |
| metylamín | CH3NH2(aq) + H2O(l)  CH3NH3+(aq) + OH–(aq) | 4,6 . 10–4 | 3,34 |
| morfolín | [O](https://en.wikipedia.org/wiki/Oxygen)([C](https://en.wikipedia.org/wiki/Carbon)[H](https://en.wikipedia.org/wiki/Hydrogen)2CH2)2[N](https://en.wikipedia.org/wiki/Nitrogen)H(aq) + H2O(l)  [O](https://en.wikipedia.org/wiki/Oxygen)([C](https://en.wikipedia.org/wiki/Carbon)[H](https://en.wikipedia.org/wiki/Hydrogen)2CH2)2[N](https://en.wikipedia.org/wiki/Nitrogen)H2+(aq) + OH–(aq) | 3,2 . 10–6 | 5,50 |
| piperidín | C5H11N(aq) + H2O(l)  C5H11NH+(aq) + OH–(aq) | 1,7 . 10–3 | 2,77 |
| pyridín | C5H5N(aq) + H2O(l)  C5H5NH+(aq) + OH–(aq) | 1,7 . 10–9 | 8,77 |
| trimetylamín | (CH3)3N(aq) + H2O(l)  (CH3)3NH+(aq) + OH–(aq) | 6,3 . 10–5 | 4,20 |

Príloha 20 – Celkové konštanty stability komplexných iónov

Celkové konštanty stability *βi* niektorých komplexných iónov vo vode pri 25 °C (iónova sila *I* = 0,0 mol dm–3) sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011 alebo z Petrucci R. H., Herring F. G., Madura J. D., Bissonnette C.: *General chemistry*, 8th ed., Pearson, USA 2017.

|  |  |  |  |
| --- | --- | --- | --- |
| Komplexný ión | Reakcia rovnováhy | *βi* | log *βi* |
| [Ag(CN)2]– | Ag+(aq) + 2 CN–(aq)  [Ag(CN)2]–(aq) | *β*2 = 3,0 . 1020 | 20,48 |
| [Ag(NH3)2]+ | Ag+(aq) + 2 NH3(aq)  [Ag(NH3)2]+(aq) | *β*2 = 1,7 . 107 | 7,22 |
| [Ag(S2O3)2]3– | Ag+(aq) + 2 S2O32–(aq)  [Ag(S2O3)2]3–(aq) | *β*2 = 4,7 . 1013 | 13,67 |
| [Al(OH)4]– | Al3+(aq) + 4 OH–(aq)  [Al(OH)4]–(aq) | *β*4 = 1 . 1033 | 33,0 |
| [AlF6]3– | Al3+(aq) + 6 F–(aq)  [AlF6]3–(aq) | *β*6 = 6,3 . 1019 | 19,8 |
| [Be(OH)4]2– | Be2+(aq) + 4 OH–(aq)  [Be(OH)4]2–(aq) | *β*4 = 4,0 . 1018 | 18,6 |
| [CdBr4]2– | Cd2+(aq) + 4 Br–(aq)  [CdBr4]2–(aq) | *β*4 = 7,9 . 102 | 2,9 |
| [Cr(OH)4]– | Cr3+(aq) + 4 OH–(aq)  [Cr(OH)4]–(aq) | *β*4 = 4 . 1028 | 28,6 |
| [Cu(NH3)4]2+ | Cu2+(aq) + 4 NH3(aq)  [Cu(NH3)4]2+(aq) | *β*4 = 5,6 . 1011 | 11,75 |
| [Fe(CN)6]3– | Fe3+(aq) + 6 CN–(aq)  [Fe(CN)6]3–(aq) | *β*6 = 4 . 1042 | 43,6 |
| [Fe(CN)6]4– | Fe2+(aq) + 6 CN–(aq)  [Fe(CN)6]4–(aq) | *β*6 = 2,5 . 1035 | 35,4 |
| [Ni(NH3)6]2+ | Ni2+(aq) + 6 NH3(aq)  [Ni(NH3)6]2+(aq) | *β*6 = 2,0 . 108 | 8,31 |
| [Zn(NH3)4]2+ | Zn2+(aq) + 4 NH3(aq)  [Zn(NH3)4]2+(aq) | *β*4 = 7,8 . 108 | 8,89 |
| [Zn(OH)4]2– | Zn2+(aq) + 4 OH–(aq)  [Zn(OH)4]2–(aq) | *β*4 = 4,6 . 1017 | 17,66 |

Príloha 21 – Konštanty (súčiny) rozpustnosti

Súčiny (konštanty) rozpustnosti *K*s niektorých málo rozpustných látok vo vode pri 25 °C (iónova sila *I* = 0,0 mol·dm–3) sú prevzaté z Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011

| Látka | *K*s | Látka | *K*s | Látka | *K*s |
| --- | --- | --- | --- | --- | --- |
| ***Fluoridy*** | BaSO4 | 1,1 . 10–10 | Zn(OH)2 | 6,9 . 10–17 |
| BaF2 | 1,8 . 10–7 | ***Chrómany*** | Fe(OH)2 | 4,9 . 10–17 |
| PbF2 | 3,3 . 10–8 | BaCrO4 | 1,2 . 10–10 | Cu(OH)2 | 1,6 . 10–19 |
| SrF2 | 4,4 . 10–9 | Ag2CrO4 | 1,1 . 10–12 | Pb(OH)2 | 1,4 . 10–20 |
| MgF2 | 7,4 . 10–11 | PbCrO4 | 2,8 . 10–13 | La(OH)3 | 2,0 . 10–21 |
| CaF2 | 3,5 . 10–11 | ***Uhličitany*** | Ce(OH)3 | 6,3 . 10–24 |
| ***Chloridy*** | MgCO3 | 6,8 . 10–6 | Fe(OH)3 | 2,5 . 10–39 |
| TlCl | 1,7 . 10–4 | MgCO3⋅3H2O | 2,4 . 10–6 | Ti(OH)4 | 7,9 . 10–54 |
| PbCl2 | 1,2 . 10–5 | NiCO3 | 1,4 . 10–7 | ***Sulfidy*** |
| CuCl | 1,7 . 10–7 | CaCO3 (aragonit) | 6,0 . 10–9 | MnS(ružový) | 3,2 . 10–11 |
| AgCl | 1,8 . 10–10 | CaCO3 (kalcit) | 3,4 . 10–9 | FeS | 1,6 . 10–19 |
| Hg2Cl2 | 1,4 . 10–18 | BaCO3 | 2,6 . 10–9 | Tl2S | 5,0 . 10–21 |
| ***Bromidy*** | SrCO3 | 5,6 . 10–10 | α-CoS | 3,7 . 10–21 |
| TlBr | 3,4 . 10–6 | CuCO3 | 2,3 . 10–10 | α-NiS | 1,1 . 10–21 |
| PbBr2 | 2,1 . 10–6 | ZnCO3 | 1,2 . 10–10 | α-ZnS | 1,6 . 10–24 |
| AgBr | 5,4 . 10–13 | FeCO3 | 3,2 . 10–11 | β-NiS | 1,3 . 10–25 |
| Hg2Br2 | 6,4 . 10–23 | MnCO3 | 2,2 . 10–11 | SnS | 3,2 . 10–28 |
| ***Jodidy*** | Ag2CO3 | 8,5 . 10–12 | PbS | 1,0 . 10–28 |
| TlI | 6,5 . 10–8 | CdCO3 | 1,4 . 10–13 | CdS | 1,4 . 10–29 |
| PbI2 | 8,5 . 10–9 | PbCO3 | 7,4 . 10–14 | CuS | 1,3 . 10–36 |
| AgI | 8,5 . 10–17 | Hg2CO3 | 3,7 . 10–17 | Cu2S | 2,2 . 10–49 |
| Hg2I2 | 5,4 . 10–29 | ***Hydroxidy*** | Ag2S | 6,8 . 10–50 |
| HgI2 | 2,8 . 10–29 | Ba(OH)2 | 2,6 . 10–4 | HgS(čierny) | 6,5 . 10–53 |
| ***Sírany*** | Ca(OH)2 | 4,7 . 10–6 | HgS(červený) | 2,0 . 10–53 |
| CaSO4 | 7,1 . 10–5 | Mg(OH)2 | 1,8 . 10–12 | Bi2S3 | 1,8·10–99 |
| Ag2SO4 | 1,2 . 10–5 | Mn(OH)2 | 2,0 . 10–13 | ***Fosforečnany*** |
| Hg2SO4 | 7,9 . 10–7 | Cd(OH)2 | 7,2 . 10–15 | Ag3PO4 | 8,9 . 10–17 |
| SrSO4 | 3,5 . 10–7 | Co(OH)2 | 1,9 . 10–15 | Ca3(PO4)2 | 2,1 . 10–33 |
| PbSO4 | 1,8 . 10–8 | Ni(OH)2 | 5,5 . 10–16 | Cu3(PO4)2 | 1,4 . 10–37 |

Príloha 22 – Štandardné oxidačno-redukčné potenciály

Štandardné oxidačno-redukčné potenciály *E*(Aox/Ared) niektorých vybraných polreakcií, stanovené pri teplote 298,15 K (25 °C) a tlaku *p* = 100000 Pa (1 atm). Polreakcie sú zapísané v tvare redukcie, tj. Aox + *z* e– = Ared. Hodnoty sú prevzaté z Lide D. R. (ed.): *CRC Handbook of Chemistry and Physics*, 90th ed., CRC Press / Taylor and Francis, Boca Raton, USA 2010, alebo Valigura D., Gracza T., Lásiková A., Mašlejová A., Papánková B., Šima J., Špirková K., Tatarko M.: *Chemické tabuľky*, FChPT STU, Bratislava 2011.

Ox + *z* e–  Red

| Polreakcia | *E*(Ox/Red) / V |
| --- | --- |
| Ac3+(aq) + 3 e–  Ac(s) | –2,20 |
| Al3+(aq) + 3 e–  Al(s) | –1,676 |
| Br2(l) + 2 e–  2 Br–(aq) | 1,087 |
| BrO–(aq) + H2O(l) + 2 e–  Br–(aq) + 2 OH–(aq) | 0,761 |
| 2 BrO3–(aq) + 12 H+(aq) + 10 e–  Br2(l)+ 6 H2O(l) | 1,482 |
| BrO3–(aq) + 3 H2O(l) + 6 e–  Br–(aq)+ 6 OH‒(aq) | 0,61 |
| BrO3–(aq) + 6 H+(aq) + 6 e–  Br–(aq)+ 3 H2O(l) | 1,423 |
| Cl2(g) + 2 e–  2 Cl–(aq) | 1,358 |
| 2 ClO–(aq) + 2 H2O(l) + 2 e–  Cl2(g) + 4 OH–(aq) | 0,42 |
| ClO–(aq) + H2O(l) + 2 e–  Cl–(aq) + 2 OH–(aq) | 0,89 |
| ClO2–(aq) + H2O(l) + 2 e–  ClO–(aq) + 2 OH–(aq) | 0,681 |
| 2 ClO3–(aq) + 12 H+(aq) + 10 e–  Cl2(g) + H2O(l) | 1,157 |
| ClO3–(aq) + 3 H+(aq) + 2 e–  HClO2(aq) + H2O(l) | 1,157 |
| ClO3–(aq) + 3 H2O(l) + 6 e–  Cl–(aq) + 6 OH–(aq) | 0,614 |
| ClO3–(aq) + 6 H+(aq) + 6 e–  Cl–(aq)+ 6 H2O(l) | 1,458 |
| 2 ClO3–(aq) + 6 H2O(l) + 10 e–  Cl2(g) + 12 OH–(aq) | 0,465 |
| ClO3–(aq) + H2O(l) + 2 e–  ClO2–(aq) + 2 OH–(aq) | 0,271 |
| ClO4–(aq) + 2 H+(aq) + 2 e–  ClO3‒(aq) + H2O(l) | 1,228 |
| ClO4–(aq) + 2 H2O(l)+ 2 e–  ClO3‒(aq) + 2 OH–(aq) | 0,398 |
| Cr2+(aq) + 2 e–  Cr(s) | –0,913 |
| Cr2O72–(aq) + 14 H+ + 6 e–  2 Cr3+(aq) + 7 H2O(l) | 1,360 |
| Cr3+(aq) + 3 e–  Cr(s) | –0,744 |
| Cr3+(aq) + e–  Cr2+(aq) | –0,407 |
| Cu+(aq) + e–  Cu(s) | 0,521 |
| Cu2+(aq) + 2 e–  Cu(s) | 0,342 |
| Cu2+(aq) + e–  Cu+(aq) | 0,153 |
| F2(g) + 2 e–  2 F–(aq) | 2,866 |
| Ga3+(aq) + 3 e–  Ga(s) | –0,549 |
| 2 H+(aq) + 2 e–  H2(g) | 0,000 |
| H2(g) + 2 e–  2 H‒(aq) | –2,23 |
| 2 H2O(l) + 2 e–  H2(g) + 2 OH–(aq) | –0,828 |
| H2O2(aq) + 2 H+(aq) + 2 e–  2 H2O(l) | 1,776 |
| H2SeO3(aq) + 4 H+(aq) + 4 e–  Se(s) + 3 H2O(l) | 0,74 |
| H2SO3(aq) + 4 H+(aq) + 4 e–  S(s) + 3 H2O(l) | 0,449 |
| H4XeO6(aq) + 2 H+(aq) + 2 e–  XeO3(s) +3 H2O(l) | 2,42 |
| H5IO6(aq) + H+(aq) + 2 e–  IO3‒(aq) + 3 H2O(l) | 1,601 |
| H6TeO6(aq) + 2 H+(aq) + 2 e–  TeO2(s) + 4 H2O(l) | 1,02 |
| 2 HBrO(aq) + 2 H+(aq) + 2 e–  Br2(l) + 2 H2O(l) | 1,596 |
| HBrO(aq) + H+(aq) + 2 e–  Br‒(aq) + H2O(l) | 1,331 |
| 2 HClO(aq) + 2 H+(aq) + 2 e–  Cl2(g) + 2 H2O(l) | 1,63 |
| HClO2(aq) + 2 H+(aq) + 2 e–  HClO(aq) + H2O(l) | 1,673 |
| Hg2+(aq) + 2 e–  Hg(l) | 0,851 |
| 2 HIO(aq) + 2 H+(aq) + 2 e–  I2(s) + 2 H2O(l) | 1,439 |
| HIO(aq) + H+(aq) + 2 e–  I‒(aq) + H2O(l) | 0,987 |
| 2 HNO2(aq) + 4 H3O+(aq) + 4 e–  N2O(g) + 7 H2O(l) | 1,297 |
| HNO2(aq) + H3O+(aq) + e–  NO(g) + 2 H2O(l) | 0,983 |
| HO2–(aq) + H2O(l) + 2 e–  3 OH–(aq) | 0,88 |
| I2(s) + 2 e–  2 I–(aq) | 0,536 |
| I3‒(aq) + 2 e–  3 I–(aq) | 0,536 |
| In3+(aq) + 3 e–  In(s) | –0,3382 |
| IO‒(aq) + H2O(l) + 2 e–  I‒(aq) + 2 OH‒(aq) | 0,485 |
| 2 IO3‒(aq) + 12 H+(aq)+ 10 e–  I2(s) + 6 H2O(l) | 1,195 |
| IO3‒(aq) + 2 H2O(l)+ 4 e–  IO‒(aq) + 4 OH‒(aq) | 0,15 |
| IO3‒(aq) + 3 H2O(l)+ 6 e–  I‒(aq) + 6 OH‒(aq) | 0,26 |
| IO3‒(aq) + 6 H+(aq)+ 6 e–  I‒(aq) + 3 H2O(l) | 1,085 |
| La3+(aq) + 3 e–  La(s) | –2,379 |
| Mn2+(aq) + 2 e–  Mn(s) | –1,185 |
| Mn3+(aq) + e–  Mn2+(aq) | 1,542 |
| MnO2(s) + 4 H+(aq) + 2 e–  Mn2+(aq) + 2 H2O(l) | 1,224 |
| MnO4–(aq) + 2 H2O(l)+ 3 e–  MnO2(s) + 4 OH‒(aq) | 0,595 |
| MnO4–(aq) + 4 H+(aq) + 3 e–  MnO2(s)+ 2 H2O(l) | 1,679 |
| MnO4–(aq) + 8 H+(aq) + 5 e–  Mn2+(aq) + 4 H2O(l) | 1,507 |
| N2(g) + 2 H3O+(aq) + 2 e–  2 NH2OH(aq) | –1,87 |
| Ni2+(aq) + 2 e–  Ni(s) | –0,257 |
| 2 NO3‒(aq) + 2 H2O(aq) + 2 e–  N2O4(g) + 4 OH‒(aq) | ‒0,85 |
| NO3‒(aq) + 3 H3O+(aq) + 2 e–  HNO2(aq) + 4 H2O(l) | 0,934 |
| 2 NO3‒(aq) + 4 H3O+(aq) + 2 e–  N2O4(g) + 6 H2O(l) | 0,803 |
| NO3‒(aq) + 4 H3O+(aq) + 3 e–  NO(g) + 6 H2O(l) | 0,957 |
| NO3‒(aq) + H2O(l) + 2 e–  NO2‒(aq) + 2 OH‒(aq) | 0,01 |
| O(g) + 2 H+(aq) + 2 e–  H2O(l) | 2,421 |
| O2(g) + 2 H+(aq) + 2 e–  H2O2(aq) | 0,680 |
| O2(g) + 2 H2O(1) + 4 e–  4 OH‒(aq) | 0,401 |
| O2(g) + 4 H+(aq) + 4 e–  2 H2O(1) | 1,229 |
| O2(g) + H2O(1) + 2 e–  HO2‒(aq) + OH‒(aq) | –0,076 |
| O3(g) + 2 H+(aq) + 2 e–  O2(g) + H2O(l) | 2,076 |
| O3(g) + H2O(l) + 2 e–  O2(g) + 2 OH–(aq) | 1,240 |
| OF2(g) + 2 H+(aq) + 4 e–  2 F–(aq) + H2O(l) | 2,153 |
| OH(g) + e–  OH‒(aq) | 2,020 |
| Pb2+(aq) + 2 e–  Pb(s) | –0,126 |
| PbO2(s)+ 4 H3O+(aq) + 2 e–  Pb2+(aq) + 6 H2O(l) | 1,455 |
| S(s) + 2 e–  S2‒(aq) | –0,476 |
| 2 S(s) + 2 e–  S22‒(aq) | –0,428 |
| S(s) + 2 H+(aq) + 2 e–  H2S(aq) | 0,142 |
| S(s) + H2O(l) + 2 e–  SH–(aq) + OH–(aq) | –0,478 |
| S2O32–(aq) + 6 H+(aq) + 4 e–  2 S(s) + 3 H2O(l) | 0,500 |
| S2O82–(aq) + 2 e–  2 SO42–(aq) | 2,010 |
| S2O82–(aq) + 2 H+(aq) + 2 e–  2 HSO4–(aq) | 2,123 |
| Sc3+(aq) + 3 e–  Sc(s) | –2,077 |
| Se(s) + 2 H+(aq) + 2 e–  H2Se(aq) | –0,399 |
| Se(s) + 2 H+(aq) + 2 e–  H2Se(g) | –0,082 |
| SeO32–(aq) + 3 H2O(l) + 4 e–  Se(s) + 6 OH–(aq) | –0,366 |
| SeO42–(aq) + 4 H+(aq) + 2 e–  H2SeO3(aq) + H2O(l) | 1,151 |
| SeO42–(aq) + H2O(l) + 2 e–  SeO32–(aq) + 2 OH–(aq) | 0,05 |
| Sn2+(aq) + 2 e–  Sn(s) | –0,138 |
| Sn4+(aq) + 2 e–  Sn2+(aq) | 0,151 |
| 2 SO2(aq) + 2 H+(aq) + 4 e–  S2O32–(aq) + H2O(l) | 0,400 |
| SO2(g) + 4 H+(aq) + 4 e–  S(s) + 2 H2O(l) | 0,450 |
| 2 SO32–(aq) + 3 H2O(l) + 4 e–  S2O32–(aq) + 6 OH–(aq) | –0,571 |
| SO42–(aq) + 2 H+(aq) + 2 e–  SO32–(aq) + H2O(l) | –0,930 |
| SO42–(aq) + 4 H+(aq) + 2 e–  H2SO3(aq) + H2O(l) | 0,172 |
| Te(s) + 2 H+(aq) + 2 e–  H2Te(aq) | –0,793 |
| Te4+(aq) + 4 e–  Te(s) | 0,568 |
| TeO2(s) + 4 H+(aq) + 4 e–  Te(s) + 2 H2O(l) | 0,593 |
| TeO32–(aq) + 3 H2O(l) + 4 e–  Te(s) + 6 OH–(aq) | –0,57 |
| TeO4–(aq) + 8 H+(aq) + 7 e–  Te(s) + 4 H2O(l) | 0,472 |
| Tl+(aq) + e–  Tl(s) | –0,336 |
| Tl3+(aq) + 2 e–  Tl+(aq) | 1,252 |
| Tl3+(aq) + 3 e–  Tl(s) | 0,741 |
| Y3+(aq) + 3 e–  Y(s) | –2,372 |